PROCEEDINGS

Ilse Bierhoff, Henk Herman Nap, Wil Rijnen, Reiner Wichert

Partnerships for Social Innovation in Europe

Proceedings of the AAL Forum 2011 Lecce

AAL
AMBIENT ASSISTED LIVING

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Cover Design: Yvonne van der Ven
Cover Photo: Creasource/Corbis

Proofreading: Academic-Editing-Services.com

Print: Drukkerij Coppelmans
Kerver 6a, 5521 DB Eersel
The Netherlands

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PO Box 8825, 5605 LV Eindhoven
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ISBN: 978-90-819709-0-7

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FOREWORD

'Active Ageing: Innovations, Market, and EU Initiatives' was the theme of the third AAL Forum in the beautiful Baroque city of Lecce. The AAL Forum 2011 invited us to discover the significant progresses made by the AAL JP projects and to think and contribute in shaping the future of ICT based supporting solutions for the senior population.

The Forum was co-organized by the AAL Joint Program (AAL JP), the Italian Ministry of Education, University and Research (MIUR), the Puglia Region, the Institute for Microelectronics and Microsystem of the Italian National Research Council (CNR-IMM), the Italian Association Ambient Assisted Living (AitAAL), the Province of Lecce, the Municipality of Lecce and Roma Multiservizi.

It was a great success with more than 600 participants who showed a keen interest in age-inclusive design and the marketing and business side of AAL products and services. The Forum proudly presented more than 10 keynotes, 5 parallel tracks, 30 chaired sessions, and over 120 speakers. The most recent EU initiatives were presented, like the European Innovation Partnership and its pilot on Active and Healthy Ageing promoted by the European Commission. A unique focus during the Lecce Forum was on Social Interactions, with the aim to bring projects together and discuss relevant aspects. Experiences were exchanged and most importantly, participants learned from the projects' success factors and obstacles.

To support our aging society, it is vital keep working together in multidisciplinary teams including industry stakeholders, scientists, end-users and policy makers. Only then we can overcome the challenges ahead and ensure a sustainable future for all. We became enthused and inspired about the dedicated and high quality work of the Forum contributors, and it will be a pleasure to welcome you to the AAL Forum 2012 in Eindhoven.

Ilse Bierhoff (Smart Homes)
Henk Herman Nap (Smart Homes)
Wil Rijnen (Smart Homes)
Reiner Wichert (Fraunhofer IGD)

Eindhoven, September 2012

THE LECCE DECLARATION

Organised by the AAL Open Association – AALOA

The European Council endorsed the European Commission's proposal for an Innovation Union in February 2011 [1], in particular the launch of a pilot European Innovation Partnership on Active and Healthy Ageing [2] as well as the new Joint Programming Initiative of European States "addressing a global megatrend" called *More Years, Better Lives* [3].

As a contribution from the AAL community, we, the signatories of this declaration, would like to provide these initiatives with recommendations that are directed at achieving an Ambient Assisted Living (AAL) market breakthrough based on an analysis of the market barriers investigated in [4].

1. Proposed Target: Ecosystems around Common Open Platforms

Current AAL research programmes are characterised by a lack of proper interaction between demand (seniors, professional and familial caregivers, insurance companies) and supply (innovative industry, SMEs, research). This results in counter-productive efforts in current R&D projects where not all stakeholders can be properly represented. Moreover, the few AAL solutions available are currently provided in a fragmented market in which the AAL industry cannot yet rely on a well-established community of major industrial stakeholders that invest in and agree upon common standards.

Experience in similar domains has shown that common platforms and ready-to-use enablers help demand-supply interactions grow into a full ecosystem of artefacts that regulates itself in a self-organising way. For example, it is inconceivable that the PC market would have reached its current state if POSIX had not provided a reference specification for operating systems, and if UNIX/Linux, Windows and MacOS had not reached their levels of popularity. Similarly, the Apache Server as a reference implementation for Web servers played a decisive role in the emergence of the Web, in addition to the standard specifications for HTTP and HTML.

Building upon the AALOA Manifesto [5], we, the signatories of this declaration, call for targeting *AAL ecosystems based on open common platforms* that facilitate the development of AAL products and services, while ensuring interoperability, financial sustainability, and the overall support of end user needs within the ecosystem.

2. Proposed Measures

Accordingly, we, the signatories of this declaration, recommend that:

- *New funding activities should be directed towards bridging the gap between R&D and bringing new products to the market* (for SMEs in particular), e.g. by promoting the convergence of similar results into established and reusable concepts, then relating the established concepts to each other in order to provide coherent views on AAL systems.
- *New programmes should include activities such as testing of competing technological enablers* (with respect to their usability and reliability under real-life conditions – e.g. by using living labs), *providing tool support, and facilitating lean development processes.* This will help R&D results to mature and provide evidence of reusability.
- *Some work should be directed at building sustainable ecosystems through targeted work*, e.g. on ecosystem design, ecosystem compliance and interoperability tests, ecosystem marketing, and life-cycle management of products and services.
- *The sustainability of the common platforms that underpin ecosystems should be promoted by supporting open, not-for-profit associations of stakeholders*, such as AALOA, to take on the role of a recognised body that guarantees the sustainability of ecosystems through platform maintenance.
- Work on creating open specifications for building blocks of the envisioned common platforms should be facilitated so that their interfaces and interaction protocols are publicly known and agreed upon in the ecosystem.
- *AAL platforms should position themselves in relation to other platform initiatives such as the Future Internet PPP* [6]. It must be possible to use technology building blocks developed elsewhere in related domains; the AAL community has to avoid the trap of relying on isolated technology that is incapable of being integrated into the wider realm of future technologies.
- *A long-term consensus building process should be initiated in the AAL community, aimed at making it possible for applications built on top of common platforms to provide value to each other*. In open distributed systems, sub-components of applications will be able to contribute to several distributed applications without even knowing all of them beforehand.
- *Education and training should be developed or adapted to take account of what results from the above recommendations* in order to train workforces that know the underlying technological enablers readily, thus reducing the long-term uptake costs for stakeholders.
- *Efficient IPR management strategies should be developed in parallel wherever stakeholders are supposed to exchange knowledge during the implementation of the above measures*, e.g. when dealing with convergence of similar results, reusability of building blocks and their APIs, positioning of AAL platforms in relation to the wider realm of future technologies, and the interoperability of applications.

3. Background of the Declaration for the General Public

Ageing populations are expected to escalate costs for the related social systems (see, for example, the OECD forecasts for Europe [7]). By using ICT to provide ambient assistance for ageing well and living an independent life, AAL can help support older people at home, on the move, at work, and in society [8], as well as to mitigate the forecast costs to society. With a growing market potential in terms of both demand (a growing population of customers) and supply (a large variety of applications), AAL systems constitute a significant economic opportunity in addition to being a social necessity (cf. also estimations in [7], e.g., about the wealth of Europeans over 65 having a revenue of over € 3000 billion, and about the market for smart home applications being set to triple between 2005 and 2020).

Accordingly, AAL systems are integral parts of the Digital Agenda for Europe [9]. Further to the 2006 Riga Ministerial Declaration on e-Inclusion policy [10], the European Commission defined an Ageing Well action plan [11] and a European strategy in ICT for Ageing Well [7]. The result is a series of measures that involve more than one billion Euros in research and development between 2006 and 2013: the Seventh Framework programme [12] funds longer-term R&D, the AAL Joint Programme [13] is dedicated to market-orientated R&D, and the ICT Policy Support Programme within the Competitiveness and Innovation framework Programme (CIP ICT PSP) [14] supports initiatives with deployment priorities.

These complementary R&D funding programmes have supported the development of numerous proof-of-concept activities in the field of AAL. However, breakthroughs in terms of widespread availability and deployment of AAL systems are yet to be achieved. The EIP on AHA and the new Joint Programming Initiative More Years, Better Lives seem to be the political answer to this situation. The AALOA Lecce Declaration tries to provide them with related feedback stemming from the hands-on experiences of the AAL R&D community.

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History of this declaration

The workshop Support for Companies with AAL solutions to Achieve Market Breakthrough (AMB'11) decided to further consolidate the ideas discussed in the workshop in an open forum towards a declaration signed by a significant part of the AAL community. AMB'11 was organised and supported jointly by the AAL Open Association (AALOA), the e-Inclusion unit of the EC, and the CMU of the AAL JP. It took place on 7th June in Brussels. The organisation of the initiative for the Lecce Declaration was mandated to AALOA. The governing board of AALOA created a Declaration Organizing Committee (DOC) consisting of Antonio Kung, Francesco Furfari and Saied Tazari who worked out a draft published on 1st July 2011 followed by four further revisions (19-Jul-11, 2-Aug-11, 22-Aug-11, and 09-Sep-11) after each round of comments. The last revision was presented in the side-event AALOA Lecce Declaration at the AAL Forum 2011 on 26th September in Lecce, Italy, where the over 40 participants ratified it with minor final improvements.

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WELCOME NOTES

WELCOME FROM THE AALA PRESIDENT

Lena Gustafsson[1]

Dear Participants,

It is with great pleasure that I welcome you to the 2011 edition of the AAL Forum in Lecce. This year, the annual meeting of the Ambient Assisted Living world is gathering in the south of Italy thanks to the support and willing of the co-organisers of the AAL Forum. Along with us the Italian Ministry of Education, University and Research, the Puglia Region, the Institute for Microelectronics and Microsystem of the Italian National Research Council, the Italian Association Ambient Assisted Living, the Province of Lecce, the Municipality of Lecce, and RomaMultiservizi.

The objective of this Forum is twofold: on the one hand the conference aims to show the significant progresses made by the AALJP projects and its practical implications on the daily life of seniors. On the other hand, considerable attention will be dedicated to the most recent EU initiatives, like the European Innovation Partnership and its pilot on Active and Healthy Ageing.

The exhibition shows many good examples of the progress and results of the AAL projects. Networking meetings and debates will stimulate to discuss and to give a ground for future initiatives in the field of active and healthy ageing.

The 2011 AAL Forum will bring together industry stakeholders, researchers, innovators, entrepreneurs, end-users and policy makers and will provide them with a unique knowledge-sharing platform to discuss the way forward of innovations for active ageing.

I hope that you will find this edition of the AAL Forum a stimulating experience to find new market possibilities, and to enlarge your working network.

Welcome to the 2011 edition of the AAL Forum!

---

[1] President, AAL Association; Rector, Umeå University

WELCOME FROM THE MINISTER OF EDUCATION, UNIVERSITY AND RESEARCH

Maria Stella Gelmini[1]

The demographic change is a very important trend in Europe and therefore Ambient Assisted Living has been included in the Strategic Research Agenda of the Italian Government as an important point for the development of new policies for ageing well and opening up for new opportunities for AAL solutions, in assistive technologies and services markets. This is one of the reasons why Italy decided to be actively involved in the AAL art.185 Joint Programme. We are therefore extremely pleased to welcome the AAL FORUM to Italy.

To this aim we think that key elements for developing the strategy are: Fostering the emergence of innovative ICT-based products, services and systems for ageing well at home, in the community, and at work. Thus improving the quality of life, autonomy, participation in social life, skills and employability of older people, and reducing the costs of health and social care. This may be based on innovative utilisation of ICT technology, new ways of customer interaction or new types of value chains for independent living services. The results of the AAL Joint programme could also be used by other groups of people, namely the people with disabilities.

Creating critical mass of research, development and innovation at EU level in the areas of technologies and services for ageing well, including the establishment of a favourable environment for participation by small and medium-sized enterprises (SMEs).

Improving conditions for industrial exploitation of research results by providing a coherent European framework for developing common approaches, including common minimum standards, and facilitating the localisation and adaptation of common solutions which are compatible with varying social preferences and regulatory aspects at national or regional level across Europe.

All of these challenges require an integrated, collaborative approach in order to take the step in implementation, mainly in a time where research and development in AAL has been advancing well but implementation is still suffering.

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[1] Minister of Education, University and Research

In this spirit, I’m pleased to welcome all the participants of the AAL FORUM 2011, in the hope that the event can offer the opportunity for useful, inspiring and enjoyable days in Italy.

WELCOME TO APULIA REGION

Nicola Vendola[1]

I am delighted to open the doors of our land to the wind of Innovation of the 3rd AAL Forum. We are aware of the new European population estimates, according to which the number of elderly persons will quickly increase. This demographic development and the ageing of the European population will lead to a growing number of older people living alone and in need of (intensive) care.

They will spend money on products securing and enhancing their wealth, safety, and security and will they have significant entertainment and communications needs. Considering that this trend will also be accompanied by a rapid growth in the number of people with physical disabilities, it is clear that the problem of care and assistance to these persons will become more and more important both from a social and an economic point of view.

These societal trends will lead to dramatic challenges for the healthcare and care systems, state pensions' schemes and employers alike, but at the same time they will offer innovation and business opportunities for technology providers in the field of "Ambient Assisted Living" (AAL).

AAL can help elder individuals to improve their quality of life, to stay healthier and to live longer, thus extending one's active and creative participation in the community. The Apulia Regional Government has recently promoted a series of interesting initiatives in order to increase awareness about these so important social issues, not only of the local authorities but also of the public opinion. Nevertheless, Research and Innovation play a key role in economic development strategy of the Region, and I am sure the AAL Forum represents a remarkable chance to stress our involvement in welfare technology.

Hosting the AAL Forum, gives us the opportunity not only of projecting Apulia in a high-tech European reality, but also of placing our Region in a cutting edge position, alongside other important Italian regions. The event is also the result of the strong interest of the Regional Welfare and Social Policies Department and its Regional Minister, Elena Gentile, who strongly believes in the power of Technological Innovation to improve life conditions of our people.

Welcome to Apulia region and to the AAL Forum.

---

[1] President of the Apulia Region

WELCOME TO LECCE

Paolo Perrone[1]

It's a great pleasure and honour for the city of Lecce to host the AAL FORUM 2011. Lecce has been involved for a long time in the challenges of the future, looking also for new opportunities in order to improve its citizen quality of life.

The event is an opportunity for the Municipality to show to the world its particular involvement and attention to the problems of the ageing society, in order to strengthen the very important role of elderly people in the society, by considering the progressive ageing of world population more meaningful here than everywhere.

In Lecce, thanks to the establishment policies for the Welfare Services, there are three cultural and leisure centres for elderly people, placed in some of the most popular areas in the city. It is a way to help old people coming from different backgrounds to improve the degree of socialisation. Our city is then very proud to host the event, showing the big interest it has in the Southern context towards the senior citizens' healthcare and their social inclusion.

I wish this edition of the AAL FORUM in Lecce can promote further and more important enhancement in the development of technological solutions for independent and active life of old people who, despite their ageing problems, are full of vitality and good examples of experience for younger people.

---

[1] Major of Lecce

WELCOME TO THE PROVINCE OF LECCE

Antonio Maria Gabellone[1]

Dear guests and participants of the AAL Forum 2011. It is with great pleasure that I welcome you to AAL Forum 2011 in Lecce. We are greatly honoured to have been chosen to host this year‘s conference.

Lecce has recently promoted a lot of important initiatives in the field of Science, Information and Technology, but it is certainly a great privilege for us to host an event of such importance as this European Forum.

Our province is very careful about the implementation of welfare technologies. The Institute for the Microelectronics and the Microsystems is the Institutional base of Italian “Ambient Assisted Living “ Association (AitAAL), that collects all the sector skills in a multidisciplinary context with the participation of public and private Research Institutes, local authorities (municipalities, provinces, Regions), and companies.

After Vienna and Odense, Lecce is set to become the centre of scientific and technological innovation too, not just on the days designated for the event, but for the whole golden future of European citizens.

While in Lecce, I hope that you will take the opportunity to see more of our province.

The city of Lecce and I extend a cordial welcome to AAL Forum 2011.

[1] President of Province of Lecce

WELCOME FROM THE CHAIRS

Pietro Siciliano[1], Kerstin Zimmermann[2]

Dear Colleagues and Friends,

I would like to deliver my warm greetings and heartfelt welcome to all Participants of the AAL Forum 2011. Welcome to the south of Europe, where the Mediterranean surrounding will set the scene for you to discuss the hot topics of ICT solutions and services for the ageing society!

The growth and prosperity of the AAL domain is challenged by two forces: the need and willingness to fund innovative ICT based AAL solutions to support seniors for an independent living and the inertia in the marketplace to take-up interesting solutions from projects and innovations. The potential is huge, to the benefit for seniors, society, investors, and industry.

The Forum will shed light on the main EU initiatives with particular emphasis on the Innovation Programme for "Active and Healthy Ageing" promoted by the European Commission. In addition, it will serve as a platform to show and discuss progress and results of AAL projects, a meeting space to network for peers and across disciplines and all interested alike in AAL developments, innovations, solutions, policies and market aspects. We hope that during the Forum fruitful interactions among participants and new cultural proposals can grow up for the positive development of the event and for the intellectual growth of all the participants.

The Forum will enjoy an atmosphere of high quality technical presentations together with a variable and pleasant social space. We present a relevant number of speakers and Chairpersons willing to stimulate you for having different ideas, considerations, technologies, etc. Thank you to them for their very interesting and stimulating contributions!

Many thanks go out to the members of the Forum Programme Committee and AALA CMU for their input and strong support in the preparation of the Programme. Many thanks also to the Regional Agency for Technology and Innovation (ARTI) and the Local Organising Committee of RomaMultiservizi.

[1] Institute for Microelectronics and Microsystems IMM-CNR and President of AitAAL
[2] Austrian Federal Ministry of Transport, Innovation and Technology

Only those who have experienced the organisation of such an important event and its related actions will understand how much human effort goes in to the preparation for these three days of intense activity.

In this context we are deeply honoured to have had the privilege to serve as Chairmen of the AAL Forum 2011 on behalf of AALA and all partners participating in the organisation of the event.

CONFERENCE SESSIONS

TRACK A RATIONALE

Wellbeing & Care of Older Adults with Chronic Conditions[1]

The focus of track A is the wellbeing and care of older adults with chronic conditions - physical as well as mental - and their carers. The first objective is to bring together Ambient Assisted Living (AAL) projects funded under call one ‘Prevention and Management of Chronic Conditions’ and other thematically related projects on the European and national levels.

In the sessions we will present several types of solutions and discuss relevant aspects regarding end user involvement and ethical issues. There will also be opportunities to exchange experiences on success factors and problems, to learn from each other and to network.

Another objective is to reflect on topics closely related to the development of solutions for older adults with chronic conditions, including:

- How can the needs and wishes of informal carers be successfully integrated?
- Which topics are missing in the AAL Joint Programme (JP)?
- How is wellbeing and care related to other domains of life?
- What is foreseen regarding wishes of future older adults with chronic conditions and what methods can be used to address these challenges?

Session A1 - The role and needs of informal carers in AAL

Carers – formal and informal - play a crucial role in the support and care of older adults with chronic conditions, thus contributing to their lives and wellbeing. Informal carers are (implicitly) included in the target groups of AAL solutions, sometimes as primary end users, sometimes as secondary end users. Formal carers or care organisations are also target groups for AAL solutions but are not the subject of this track.

In this session we aim to provide a forum for active learning, discussion and debate around the need to develop effective and meaningful collaboration. We will explore how we can incorporate the needs, wishes and aspirations of informal carers in the development of Information and Communications Technology (ICT) based solutions to support older adults and to support people with chronic conditions, including cognitive impairments.

[1] AAL Forum 2011, OnSite Guide and Programme

Session A2 - Physical and mental wellbeing and care for older adults with cognitive impairments and their relatives and carers

In the coming decades, the number of older adults with cognitive problems, such as dementia, will increase substantially and there are concerns about how to sustain or improve their quality of life, how to provide and finance the care and support for them, and how to help them retain their social networks.

In AAL and other EU and national programmes, several projects are developing ICT based solutions for people with cognitive impairments and their (in)formal carers. Solutions that improve quality of life, sustain autonomy, provide safe environments and that relieve the burden on carers. In this session we will present an overview of AAL solutions 'under development' for people with cognitive impairments, mainly dementia. Furthermore we will discuss highly relevant topics such as the involvement of end users with cognitive impairments, specific ethical issues, the role of informal carers and the requirements for implementation.

Session A3 - AAL solutions for self-management of chronic conditions by older adults

Self-management of one's chronic condition(s) can play an important role in sustaining autonomy and wellbeing. In AAL several projects are developing ICT based solutions to support self-management for older people. They consist of personally monitored and tailored programmes for training or daily life activities.

In this session we will give an overview of AAL solutions for self-management, categorized on several dimensions. For example

- the type of content(e.g. self-management of physical activity, daily task structure, social relations).
- the level of cognitive activity that is supported (e.g. support through implicit motivation or support of daily living activities).
- the amount and type of feedback and type of measures that the system generates.

Related aspects of self-management will be discussed and taxonomy of existing AAL solutions for this area will be presented. Prototype systems from AAL projects will be presented as case studies. The AAL taxonomy is helpful for users searching the market for systems that could meet their needs. The taxonomy also provides a guideline for further innovation in existing or new systems.

Session A4 - ‘Pecha Kucha’: networking for learning and partnership

This session is a structured networking event. We will provide projects and participants with opportunities for networking and collaboration, based on individual questions and topics via the ’Pecha Kucha’ method.

Session A5 – Topical gaps and issues for future development in AAL

The AAL JP covers many domains and topics where older adults might benefit from desirable ICT based solutions to improve their quality of life and independence. Now that we are at the halfway point of the AAL JP, it is therefore timely to reflect on any issues that may have been overlooked as well as to examine what could be missing from the AAL portfolio regarding wellbeing and care for older adults with chronic conditions, including cognitive impairments.

Furthermore now is the time to look into the future, e.g. the coming 20-30 years. What developments can we expect in terms of the wishes, desires and needs of older adults and how might ICT based solutions help support them? What other methodologies might be used?

TRACK A NOTES

SESSION A1: THE ROLE AND NEEDS OF INFORMAL CARERS IN AAL

Lydia Feige and Geja Langerveld[1]

Session A1 took place in a warm and friendly atmosphere. About 50 people attended this informative session, chaired by Mrs. Jackie Marshall-Cyrus from the Technology Strategy Board, UK. The main theme, 'the role and needs of informal carers in AAL', was viewed from different perspectives by four lecturers.

Licia Boccaletti from Eurocarers defined informal carers as persons who provide unpaid care to someone with a chronic illness, disability or other long-lasting health or care need, outside a professional or formal framework. They may be spouses, children, friends… She gave an insight into the burden of informal care and explained that assistive technologies can help to relieve this burden by increasing 'self-doing' by older people, monitoring and alarm functions, easy treatment/medical devices to operate at home, social networking, peer support, information and training. ICT can also simplify long-term care systems and improve cooperation between different types of carers. Finally, Licia mentioned that many senior informal carers are not familiar with technology. They might need support to find useful solutions and shape them to their needs and they might also need training to use ICT. Involvement in the development of solutions is crucial.

Patrizia Di Santo (StudioCome) talked about the European project INTERLINKS, the role of informal carers in the long-term care system. She provided some statistics about the role of the >100 million informal carers in the EU: 76% women, average age 55, providing an average of 60 months of informal care for around 45 hours per week. She emphasized that informal carers have their own needs for support.

The EU countries have varying policies and legal responsibilities for families and (local) authorities in the financing and provision of care. Also the increasing role of migrant workers and the consequences were mentioned. The strengths of ICT are the improved quality of life of older adults and informal carers because of higher autonomy, less stress and social isolation, easily accessible information and training opportunities. Perceived weaknesses have to do with costs, technical problems, the digital divide and the necessity to develop a common language between developers and different user groups of ICT solutions.

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James Stewart (Information Society Unit of the EC) presented the theme of impact assessment of initiatives using ICT to support family carers of older people. In 2009 research started in this area and since then 52 initiatives have been mapped. Most are local initiatives, often not well documented, with mixed funding and heterogeneous experimentation. At the moment little systematic evidence of the impact at any level is available. There is some evidence for how success can be scaled or transferred to other contexts and a few are set up to 'scientifically' prove their benefit in real life social experimentation. So, there is a clear need and existing supply, but more, and better quality evidence is necessary to support policy decision making and encourage investment and innovation. A new study CARICT started in 2011 to assess the impact of ICT-based solutions for informal carers on the sustainability of long-term care in the EU. At the end of his presentation, James called on everyone to tell him about any new examples of AAL solutions and evidence of their benefits.

Sue Howard from the Yorkshire Film Archive, gave an insight in to the Memory Bank. This creative approach gives access to over 16,000 non-fictional materials (documentaries, advertising films, professional and amateur collections) from recognisable time periods and (national, regional) events and situations. These films can be used as a means to stimulate recall, or to discuss and share experiences within the family, social networks or, e.g., in care organisations. The aim is connecting to the past and enjoying it together. To achieve this, themed Memory Bank DVDs have a simple to use format, each DVD containing six films. Each film has three prompt points to indicate subjects for discussion as well as background notes, suggestions for further activities and accompanying still images. Evaluation shows the impact of Memory Bank content on increasing communication, sociability and wellbeing. There were positive results and feedback from users. Memory Bank will develop further both online and off line.

SESSION A2: PHYSICAL AND MENTAL WELLBEING AND CARE FOR OLDER ADULTS WITH COGNITIVE IMPAIRMENTS AND THEIR RELATIVES AND CARERS

Anna Felnhofer & Oswald D. Kothgassner

Embedded in the overall track "Wellbeing & care of older adults with chronic conditions" the present session particularly tackled the issue of providing adequate care for older adults with long-term cognitive impairments. A review of European dementia projects provided by track chair Geja Langerveld revealed that most projects in this area predominantly focus on giving cognitive support, on providing more security via monitoring and surveillance systems and on enhancing activities of daily living (ADL). Only a few projects broach equally important issues such as stimulation of self-care in dementia patients, enforcement of physical rehabilitation and entertainment.

In accordance with these findings, the projects subsequently presented within this session primarily concentrated on monitoring and detection systems: the project ALADDIN for instance, introduced by Maria Haritou (Institute of Communication & Computer Systems, Greece), embraced a telemedicine software for home use which in case of danger releases a notification to a medical practitioner. Similarly, the ROSETTA project presented by Tessa Overmars-Marx (Vilans, The Netherlands) aimed at enhancing the patient's security by introducing multiple sensor systems connecting the patients with their caregivers. Additionally the system aimed at supporting people with dementia in carrying out their ADL. Another project using multiple alarm systems to facilitate the overall care of cognitively impaired older adults was BEDMOND, introduced by Bernhard Woeckl (CURE, Austria). The presented system included numerous operations, such as time and drug management functionalities as well as security functionalities for patients and decision support functionalities as well as questionnaire management for caregivers. The last project, HERA by Konstantinos Perakis (HYGEA, Greece), is predominantly focused on improving the mental, physical and social wellbeing of cognitively impaired individuals. Using a specialized e-service, an older person's ADLs such as drug intake, measurement of body weight and blood pressure were meant be supported by the HERA system.

Several ethical issues arose in the course of the presentations and were – if possible – tackled by the presenters themselves: for most of the above-mentioned projects issues pertained to data security and the steps taken to ensure it. Especially in light of multiple sensor systems recording diverse data, questions such as “who has access to the recordings or to the patient’s data base?”, “who can make changes to the recordings?”, “do the patients themselves have the right to access their data?” revealed the need to clarify ethical guidelines for ethically sound project procedures. Another issue raised with regard to the highly vulnerable population of dementia patients pertained to informed consent procedures used in the projects and the question of who eventually gave consent.

Next, the session chair Dianne Gove presented Alzheimer Europe’s work on ethical issues, providing the previous project-based discussion with a wider frame of ethical debate around AAL solutions and research on/with elderly people. Dianne Gove especially stressed the importance of reflecting upon ethical aspects such as dignity, autonomy, beneficence, non-maleficence and justice prior to launching a research project. In addition, and with special regard to the vulnerability of dementia patients, several practical ethical issues – the person’s capacity to give consent, his or her needs and benefits such as overall risks and costs – were pointed out as highly relevant to AAL research endeavours.

The session concluded with a lively discussion and many questions concerning both the projects’ content and surrounding problems, such as the issue of the systems’ effectiveness. As all of the above-mentioned projects are currently in a trial phase and the technology prototypes are merely being tested on few subjects, there are no tangible results on the technology’s effectiveness or on its impact on the everyday life of the target group. Furthermore, methods of distributing, financing and installing such home systems have yet to be developed and successfully implemented in home care settings. Additionally, an exchange of knowledge and research results such as the discussion of obstacles and troubling occurrences among the very similar, virtually complementary projects would add to a standardization of research methods and far-reaching mutual benefit.

SESSION A3: AAL SOLUTIONS FOR SELF-MANAGEMENT OF CHRONIC CONDITIONS BY OLDER ADULTS

E. Torta[1], S. Spinsante[2]

Introduction

Session A3 provides an overview of current AAL projects whose common aim is to stimulate self-management in older adults with respect to chronic diseases but also autonomy and wellbeing. These projects are brought together with the aim of fostering discussion and exchange of ideas and experiences, according to the need that emerged from the AAL Forum 2010. Five AAL projects (call 1) were presented: IS-ACTIVE, PAMAP, the RGS, EmotionAAL, and A2E2/V2me.

The need for taxonomy

Different systems are proposing solutions for self-management; such solutions are different in certain aspects and similar in others. Therefore there is a need for a more scientific and effective approach related to these systems' classification and evaluation. Roelofsma proposes the use of a five-dimension taxonomy for system classification that can be helpful in identifying unanswered questions and solutions.

The first dimension refers to the user group for whom the system was designed and developed. According to Roelofsma, the target group of most of the self-management projects is older adults affected by dementia or Alzheimer's disease (26%), followed by fall detection (17%), motion and mobility issues (17%), physical activity (13%), medication supplies (13%), COPD (9%) and CHF (4%).The second dimension is related to the setting, i.e. where the system is deployed. It can be in the subject's home or not, in rural or urban areas, in a clinical setting or not. The third level of classification is related to the system's functions and it determines which measurements are adopted for reporting the system's performances. Measurements represent the fourth level of classification.

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The last level of classification is related to the approach the project uses to assess the cause-effect relationship (descriptive – correlation – comparative – experimental approach). These five dimensions should help to describe quickly and objectively a project and its target. A comprehensive taxonomy should have 11 items for project evaluation.

Project IS-ACTIVE, Inertial Sensing Systems for Advanced Chronic Condition Monitoring and Risk Prevention

The project focuses on the development of a Wireless Sensor Network (WSN) for motion monitoring and risk prevention in older adults affected by COPD in order to improve their self-management. The project aims to design an effective sensing system for daily use that motivates the patient to do physical activities. The system presents an easy-to-use interface and a prototype wireless sensing platform called ProMove. The project involves universities, industry and medical research centres, related to hospitals/rehabilitation centres. The system provides real-time feedback to motivate the persons to do more physical activity. The sensory network comprises wearable sensors (inertial sensors) and sensors which are placed in objects that the user manipulates during exercise (physiological sensors). Sensing devices are smart phones and pulse-oximeters. Feedback is given by means of smart phones and tablets. For exercise coaching, the project's team developed a game that stimulates activity and makes use of a sensorized dumbbell that relies on the ProMove platform. The graphical user interface (GUI) of the dumbbell is a submarine: the person moves the arm and the submarine moves to catch the bubbles. The dumbbell has sensors to monitor the person's activity level. Results show that the use of smart phones was positively accepted by the users, while tablets were less accepted by the AAL age group. In general, it emerged that education is an important factor for using the system. Some improvements are needed in the user interfaces and instruction manuals. Field trials (1-3 months in patients' homes) are scheduled for autumn 2011.

Question and Answer:
Q: Have you looked at how to motivate the patients to use the dumbbell and do exercises?
A: The game was designed to be fun. The dumbbell is an object and not a means to interact with the computer, and it was accepted by the users.

Project PAMAP, Physical Activity Monitoring for Ageing People

The PAMAP project deals with physical activity monitoring for ageing people. It is well known that several geriatric issues are connected with chronic conditions: deficit of physical activity, improper rehabilitation after surgery and severe diseases. It is consequently important to promote the practice of a physical activity (PA) in older adults for prevention and rehabilitation. PA promotion is performed not only by checking the seniors' activity but also by motivating them during the execution of the exercise.

In order to be effective, the system should monitor and also support the PA of the patients, thus increasing the self-management and independence of older adults. The proposed system includes body sensors, a real time user interface, and data processing for PA analysis; the management of data and information is left to the users' supervisors. Medical supervisors merge the patients' electronic health records, PA, and motion viewer to provide health plans. Two categories of PA are recommended: aerobic or endurance PA (cardiovascular health), and strength or stretching PA to improve the body strength. The system helps the person to perform his programme and checks the correct execution of it. The system provides easy-to-understand feedback to motivate the users. During aerobic PA, such as walking or running, the user wears sensors for data collection, whereas data classification and learning is performed offline. During strength PA, the system helps the person to learn how to perform the exercise and provides feedback about its execution: the actual exercise is compared to the ideally executed one, and feedback is provided if the exercise is not done well. Correcting advice and motivational feedback are provided by the system.

RGS, Rehabilitation Gaming System

The project focuses on the use of a virtual reality platform for upper limbs motor rehabilitation in stroke patients. As a matter of fact, in stroke patients, some cognitive and motion impairments remain after treatment. Furthermore it has been shown that if stroke patients are not provided with the right supervision, they typically lose motivation to continue exercising.

Evidence from neurosciences suggests that motor functionality can be recovered by cortical plasticity and that the mirror-neuron system can be exploited to recover motion functionalities, it having been shown that different arm motions with the same goal stimulate the same neurons.

The system includes a camera, gloves, and the Kinect sensor by Microsoft ®. The system adjusts the content of an interactive virtual game according to the patient's performance and needs (assuming the patient is always putting his maximum effort into the task).

The system has been tested by different patient categories (acute, sub-acute, and chronic) in different hospitals. Results show that the system accelerates the recovery process and that, after 6 months, there are no differences between the results related to the use of traditional rehabilitation treatments and results related to the use of the RGS system. Tests show that patients desire more gaming scenarios and that they prefer to reduce their dependence on the therapists. On the other hand, caregivers suggest including more social interaction in the game, more supervision and less invasive devices (data gloves). Future developments will include a touchscreen interface to allow users to configure the system and will create a network among users and caregivers related to the use of RGS. Data from rehabilitation sessions will be sent to a central database that will be used by the caregivers to tune the therapy and treatments.

EmotionAAL, The Emotional Village: Integrated Preventive AAL Concept For the Rural Ageing Society in Europe

The EMOTIONAAL project aims to implement a pilot "health shop" to foster social participation and integration of older adults, together with disease prevention. The aim is the integration of new technologies in the daily life of older adults living in rural areas by means of rural units connected to ICT services, in order to support social life and the gathering of physiological data for prevention and intervention.

The migration of young people from rural areas to towns reduces the economic sustainability of older adult communities in such areas. Shops are closing (due to the lack of potential buyers) and real estate prices are becoming low. Money needed during the old age is usually obtained by selling the house where the older adults live, but if prices fall older people cannot gather enough resources to sustain their old age.

EmotionAAL envisions that the delivery of daily goods at home, disease prevention, and health biofeedback may be managed by a local shop in the rural community which should also be accessible on the web. In the proposed scenario, old people visit the shop daily to measure health parameters and get other information and services (physical, mental, and preventive support). In this way, telemedicine services are delivered inside a shop which they used to enter only to buy daily goods and groceries.

The project foresees two scenarios: patient@shop, and patient@home. Pilots are currently deployed in Germany and Finland. In Finland, the distances between patients and doctors are greater than in Germany, so it is expected to make much broader use of self-telemedicine systems there. Questionnaires are delivered to the users in order to evaluate the effectiveness of the proposed solution. Results show that users were happy to measure their health conditions in the shops and would not prefer to do it by themselves at home. They appreciated the holistic approach of the project, in which the shop is seen as a unique selling point.

A2E2, Adaptive Ambient Empowerment of the Elderly & V2me, Virtual Coach reaches out 'to me'

The project aims to evaluate the impact of the environment on human behaviour. The purpose is to create healthy living environments for older adults, tackling issues related to social connectedness, the prevention of social exclusion and loneliness. Among the different aspects covered by AAL technologies, the attempt to keep people socially connected is of importance. Furthermore, according to social science theory, an adaptive ambient empowerment of older adults lowers the risk of contracting diseases. The project foresees the presence of a so-called "programme manager", Adaptive Ambient Empowerment of the Elderly, which is in charge of creating tasks for the daily activities of the senior. The tasks are delivered to the person by a virtual coach (avatar) through a television. The system stimulates the person to measure her weight or do activities such as going out or buying groceries. The tasks are scheduled throughout the day and the coach interacts with the person whenever the person has completed a task. The person interacts with the virtual coach by means of a touch screen. It is expected that bringing animated characters into the AAL world may have a remarkable effect on patients' motivation. Almost 200 persons in the Netherlands will test the system.

Discussion

After the presentations, all the speakers were invited to the podium for discussion and a Q&A session. The basic conclusions drawn from the discussions are listed in the following.

1. Are projects focused on compliance or self-assessment/management?
   When the project focuses on rehabilitation or on the older person's physical activity, both aspects are important. The system design needs to be accurate and to ensure compliance. When the focus is on rehabilitation, the process needs to be simple and effective and to have control of the environment. In the IS-ACTIVE project, the user has to be active no matter what kind of exercise he performs; he can choose the activity he likes. The EmotionAAL project aims to shift the responsibility for health-management from doctors to patients. The A2E2/V2me project shows that the engagement with the coach reduces loneliness, but much work is still to be done, for example, to understand what the best avatar is for motivating people.

2. All the projects try to integrate the assisting environment in the patient's life. They agreed that it is not a natural way of interacting to push a button on the graphic interface of a touch screen. People go to shops because they want social contacts and not because the avatar coach tells them to do it. Social interaction is recognized as a key factor to improve the user's performance and involvement. For example, in the case of RGS, sharing the user's performance in a multi-player scenario increases motivation. The social dimension of the system is a critical factor for a successful project outcome. In the EmotionAAL project the user decides if he wants to share his data with relatives, friends or caregivers. Social networks may be really motivating, but they can also be a way to control the patients through the collection of their personal data.

3. Did you measure physiological data during the exercises of stroke patients?
   Yes, data are measured and sent to the medical doctors to help them to analyse the patient's performance better. These data are also used by the system to adapt the game to the user's needs. Data are measured only when the system is deployed in hospital and not in people's homes.

SESSION A5: TOPICAL GAPS AND ISSUES FOR FUTURE DEVELOPMENT IN AAL

Aliaksei Andrushevich[1], Mario Conci[2]

Session A5 of the AAL Forum in Lecce was held under the motto "Mental health goes mobile, personal and social". The idea of innovation is to find what makes it different and difficult. The topic of the overall discussion was "care and cure".

The first talk by Dr. Heleen Riper was devoted to the topic of e-mental health for online prevention of mental disorders.

The main theses of the speech are:

1. AAL should not be focused only on older people, because there are other kinds of problems (like diabetes and depression) that are common also to youngsters. For this reason, the ICT and AAL should open up to the young age group.
2. The most common diseases in 2030 (in developed countries) will be depression, alcoholism, dementia and diabetes (in particular, depression is ranked 2° worldwide).
3. More attention should be given to e-Mental Health. Mental Health 2.0: Prevention and treatment. In Mental Health 2.0 patients have an active role in managing their health, and there is a shift from the clinic to the patients' families and daily lives through prevention and treatment online (using ICT and social networks).
4. A robust clinic base with a number of trials is needed. The speaker reports a study on Online Screening Meta-Analysis (10-15 studies). The results show that the more online guidance you give, the better the patients get. We can consider online treatment effects as being similar to face to face.

Conclusion:

e-Mental Health is more effective than F2F treatments because it reaches more people. Although there is a very important role for online support, ICT-based solutions lack the human touch. To promote mental fitness, there are websites with exercises, self-screening, diagnosis, relapse prevention, chronic care.

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[1] iHomeLab

[2] Fondazione Bruno Kessler

A comment on e-Mental Health: cognitive treatment can be more effective than pharmaceutical. But we don’t reach people over 65 years old via online activities. An interesting fact is that the penetration of mobile phones is higher than PC penetration, and is already 45% in Africa, for example.

Discussion

Q: What kind of mental problems are recognized and found the most in old age?
A: We don’t have access to enough elderly to give you exact and detailed statistics. However, all the depression symptoms are approximately split at a proportion of 2 / 3 women and 1 / 3 men. Men have more alcohol problems.

The second talk by Prof. Dr. Eckehard Fozzy Moritz was devoted to the topic of Holistic Innovation by System Visioning

The main theses are: What / Why / How – system visioning in the example of the Healthy Office. It is based on the question: how will the proposed solution look 10-15 years from now?

System Visioning: an approach to preconceive and conceptualize a potentially useful system perspective of a feasible, plausible, desirable, future in an innovation field.
We need this approach because it:

- gives orientation and coherence to innovation efforts
- prepares the way for systemic thinking
- allows us to identify breakthrough development through retropolation.

Boundary Conditions <-> Innovation Enablers (new scientific knowledge and preventive health) <-> Innovation Opportunities <-> What Functions (stress reduction, movement opportunities, healthy nutrition, mental balance)

Conclusion:

The methodology for system visioning should be applied in choosing the topics for the next AAL-JP calls.

Remark:

The healthy office is only one perspective or layer. We have to catch the most significant target groups at a younger age for the healthy office. We have to ensure acceptance of the adaptation to the environment and user context. Otherwise, the solutions will not be used.

Discussion:

Q: Please give more explanatory details on the comparison between AAL and mental health.
A: Three messages: lots of decisions should be eliminated, like the age range perspective of > 65; differentiation between online and offline; combine AAL and eHealth, senior games to incorporate mental health and behaviour change into the AAL projects.

AAL should open up to younger workers because:

- older people do not work
- young workers are stressed

Define the problem and see how you can collaborate by getting rid of the existing focus/categories. It is not the technology but the economy that looks at the demographic statistics. And there are some statistics we don't use that we have to add. The economy should support the life of human-beings, and not vice versa.

Q: Bridge between users-at-home and services for elderly. Can you foresee when local governments will contact end-users to offer ICT use? When will closer collaboration between eHealth and traditional Health be achieved? What is needed to achieve this collaboration?

A: The new generation uses mobile devices to monitor our physical and mental health because health providers monitor the development in a better way. Healthcare providers should monitor the progress of the patient and quality of treatment through a higher interaction with PROACTIVE users, and make them more able to manage their own health. Driven by mental health research questions, we could establish some reasons to participate in AAL.

Closing thesis:

Self-management is important, regardless of statistical age. Let us focus on our mental age, we are all young!

TRACK A PAPERS

ALADDIN: A HOME CARE SYSTEM FOR THE EFFICIENT MONITORING OF ELDERLY PEOPLE WITH DEMENTIA

Maria Haritou[1], Silke Cuno[2], Yuri Glickman[2], Aggelos Androulidakis[1], Andrej Baboshin[2]

Abstract

ALADDIN's objective is to develop a trustworthy and reliable system supporting patients with dementia and their informal carers in the management of the disease from home. Based on a set of monitoring parameters and measuring scales feeding the risk assessment component, the system aims at early detection of symptoms that predict decline, avoid emergencies and secondary effects and, ultimately, prolong the period for which patients can remain safely cared for at home. Informal carers are also closely monitored by the system, while additional features supporting networking, education and cognitive stimulation are also integrated, along with decision support and patient management tools for the treating clinicians. The platform has been built based on credible methodologies for efficient patient follow-up, risk detection and adaptive care. It is an open, secure, interoperable, integrated IT solution designed according to Service Oriented Architecture principles. The system has been developed within the framework of the ALADDIN project funded by the AAL Joint Programme and is currently being evaluated through a pilot operation conducted in three AAL member states. This article presents the ALADDIN system in the context of the A2 session of the AAL Forum 2011 in Lecce.

1. Introduction: Dementia - a leading cause of concern in the ageing society

A specific area of interest as regards chronic diseases is that of patients with cognitive impairments and mental disorders, which is attracting increasing attention as society gradually ages. Dementia is one of the leading causes of concern in the elderly. It is one of the most debilitating and stressful conditions that patients and their carers can experience, manifesting itself through memory loss, impaired cognition, behavioural problems, loss of orientation in time and space, motor deficiency and at later stages

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even delusions, hallucinations, sleep disturbances and aggressive behaviour. On the personal level, dementia reduces quality of life and independent living. On the socioeconomic level, it is one of the major causes of the increasing cost of health care for the elderly population, with severely demented patients requiring constant supervision and medical care [1, 2]. People with dementia live in different types of care settings depending on the level of care they need (assisted living, day-centres, residential units). It is estimated that 40% of people with dementia live in long-term care (institutional settings), whereas the majority of the patients (60%) live in the community, supported by carers or living alone. The role of the main carer is often assumed by an equally elderly spouse or another close relative. The carers of demented people may themselves in turn suffer from stress, over-work, depression, and also be physically affected.

Experts estimate that 35.6 million people worldwide suffered from Alzheimer's Disease (AD) alone in 2010, with the numbers expected to nearly double every 20 years, to 65.7 million in 2030 and 115.4 million in 2050 [3]. The World Health Organisation estimates that globally the total Disability Adjusted Life Years (DALY) for AD and other dementias exceeded eleven million in 2005, with a projected 3.4% annual increase and accounting for 4.1% of the total disease burden (DALY) among people aged 60 years and over, 11.3% of years lived with disability and 0.9% of years of life lost. According to a recent study by the European Commission regarding the state of dementia in Europe, there are now more than 6 million people with dementia in the EU. In some countries, support from the State for people with dementia and carers (e.g., in the form of services, allowances and care structures) is quite well developed, whereas in others it is virtually non-existent [4, 5]. While there are many positive aspects of caring, carers of people with dementia are very likely to experience strain – and significantly more than the strain manifested in other carer groups. It is reported that 40-75% of the carers develop significant psychological illnesses, and 15-32% of these are clinically diagnosed with major depression. There may also be physical health consequences - strained carers have impaired immunity and a higher mortality rate. Moreover, informal carers experience increased rates of absenteeism from work and also bear increased costs associated with the patient's care.

Reflecting the importance of the demographic change and its consequences on the quality of life of the citizens, European governments intensively promote and finance research and development of successful concepts and technologies that allow older people to lead an independent and responsible life for as long as possible - to strengthen the dignity and quality of life in their central living space: their own home. Home and family environments move towards the centre of attention. To attain these goals, homes have to be remodelled and equipped so that older people can cope with their daily lives in their familiar environment, even if they are already dependent on additional support or care. The key to this is seen in age-appropriate assistive systems like AAL, based on modern, unobtrusive micro systems and advanced information and communication technologies. In this respect, a significant number of ICT-enabled systems and services, computational models, micro and nano sensors and devices, sensor networks with advanced processing capabilities, smart home implementations and many others have been developed and put forward to achieve the goal of prolonging the time that older people can continue to self-manage in their own homes. However, in the specific case of older people suffering from dementia, which is known to impose a significant burden on the informal carers involved, it is important that the technological solutions proposed also take into account and provide for the wellbeing of the carers. Therefore, apart from monitoring and assistive technologies, the elaboration of a novel care methodology is required for the home management of dementia, allowing for both the delayed institutionalisation of the patients and the close monitoring and support of the informal carers in order to preserve their quality of life and relieve their distress.

In the above complex context, the objective of the ALADDIN project [6] was to create a technology platform and a novel care methodology allowing for remote health and physical monitoring, cognitive and behavioural assessment, early detection of symptoms that predict decline, personalised care delivery and individualised treatment planning, along with multi-level support services to all the actors involved in the care of patients suffering from dementia.

The platform supports carers, patients, clinicians and other service providers in efficiently planning, managing and monitoring the patients' and carers' health status, primarily to avoid emergencies and secondary effects caused by a cognitive, psychological or behavioural decline of the patient, and secondarily to relieve the stress experienced by the carer, so that the Quality of Life of both can be maintained and optimally supported. The term Quality of Life (QoL) is used to evaluate the general wellbeing of individuals and societies and has recently developed into a research topic of its own. Research units around it were built up and conceptual frameworks worked out, to develop, evaluate and apply QoL measures within health-related research, some of which are integrated also in the ALADDIN platform.

2. ALADDIN monitoring and supporting services

In conventional clinical practice, the diagnosis of dementia and the assessment of disease progression are mainly based on a multi-tasking clinical approach, including as a first line conducting neuropsychological tests, with the Mini-Mental State Examination (MMSE) [7] being the most widely adopted. In the MMSE test, scores range from 0 to 30, with scores less than 24 typically associated with dementia. Other tests have also been developed, enriching clinicians' arsenal in their diagnostic work and several scales are also widely used in clinical practice alongside the MMSE, providing additional or supplementary assessment capabilities. The most frequently used of these neuropsychological assessment scales are the Memory and Behaviour Problem Checklist (MBPC) [8] and the Clinical Dementia Rating Scale (CDR) [9, 10].

In the ALADDIN monitoring system, a sub-set of questions from each of these tests has been selected for integration into the ALADDIN patient questionnaire which, in its complete form, comprises 32 questions – one of which is illustrated in Figure 1. The questions are organised in clusters aiming to provide multiple-context patient assessment as regards (a) temporal and spatial orientation, (b) psychiatric and behavioural symptoms (PBS) - further organised into cognition, aggressiveness and mood clusters - and (c) functional capacity in performing daily life tasks. In addition to the above, there are also questions related to the drug therapy administered, the use of conventional healthcare resources (emergency calls or visits, contacts with doctors, nursing staff, social workers, etc.) and finally there is also a free-text option, allowing the carer to express any other concern about their relative. Each question integrated in the test is associated with a specific numeric value depending on the answer given. In this way, scores are registered both at the level of individual questions, and at the level of clusters and, of course, the whole questionnaire.

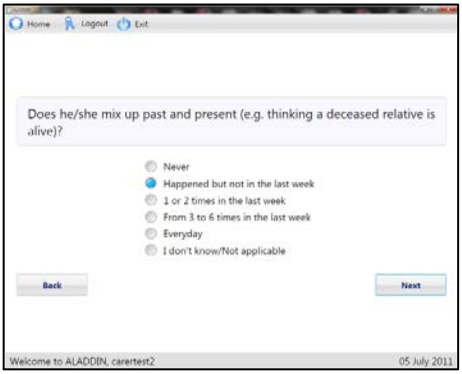

Figure 1: Example of how a question is displayed and answered through the ALADDIN software. This is the first question of the cognition cluster of the patients' questionnaire**.**

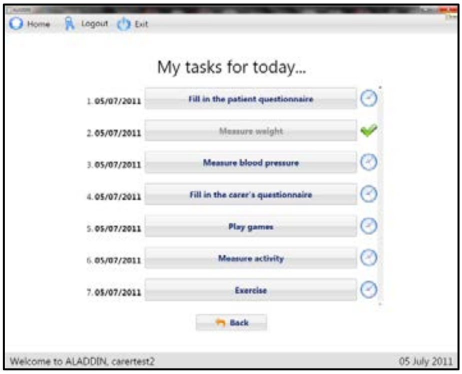

Figure 2: The list of tasks for today to be performed by the carer/patient in the ALADDIN application. In this example the task "Measure weight" is completed. Others are waiting to be performed**.**

Apart from the neuropsychological assessment questionnaire, the patient, either alone or assisted by the carer, performs some additional simple measurements of two physiological parameters of interest, namely blood pressure and body weight, and feeds the system with the measured values. Finally, an actigraphic device in the form of a wrist-band is worn by the patient throughout the day, providing indices of their activity levels during the day and night and therefore some indications of anxiety, insomnia, apraxia, etc., which can be estimated by this type of monitoring. The frequency of the checks is defined by the doctor, according to the specific needs of each individual patient. The clinician can also easily add or remove questions from the patient questionnaire, allowing individualised assessment tests to be tailored to the specific patient profile.

The scores registered by filling out the patient questionnaire along with the values of the other monitored parameters, are stored by the system and fed into the risk assessment and analysis component (RAAC) [11], which processes the specific patient recording against a set of pre-defined rules and thresholds set for that patient at the beginning of the systems' use. If there are persistent deviations of the collected data from those obtained in previous patient recordings, an automatic warning is generated and stored, together with the patient's specific recording, triggering an evaluation from the treating clinician and a subsequent corrective action or medical intervention if necessary.

As for the patient, a carer questionnaire has also been implemented and integrated into the ALADDIN system, comprising 40 questions representing (a) the Zarit Burden Interview [12] for the assessment of work load, (b) a subset of the MMSE for mental status assessment, and (c) the Quality of Life measuring scale [13]. Again, the frequency of filling out the carer questionnaire is defined and can be customised by the doctor. The list of tasks assigned to the patient and carer by their doctor is shown in Figure 2.

Apart from the purely medical monitoring that comprises the core of the ALADDIN platform, a number of additional features in the form of external services have also been linked and integrated into the system, providing means for networking, education, and cognitive and physical exercise. Through these functionalities, patients and carers can access their personal discussion forums, allowing them to exchange and share their concerns and ideas with their counterparts. They can also access educational material and other relevant information selected by the clinicians, or they can engage in executing a cognitive stimulation exercise or physical exercise assigned to them by their doctor for the specific day. Figure 3 shows the home page of the patient/carer application through which they can access the different system features.

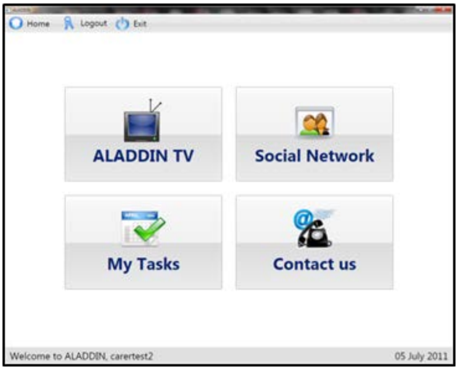

Figure 3: The main menu of the ALADDIN application

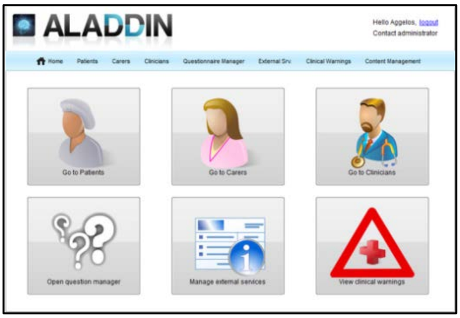

Figure 4: The ALADDIN portal for clinicians

In summary, the control parameters integrated in the platform are:

- Evaluation of the patient's quality of sleep and physical activity
- Evaluation of the patient's general health aspects and the nutritional state
- Monitoring of the patient's cognitive functions and provision of cognitive stimulation exercises
- Detection and control of the patient's psychiatric and behavioural symptoms (PBS)
- Monitoring the patient's performance in daily physical and social activities
- Control of the patient's side effects and adherence to pharmacological treatment
- Registering the use of resources by the patient or the carer
- Control and monitoring of the carer's workload
- Monitoring of the quality of life of the carer
- Monitoring of the mental health of the carer

The infrastructure that needs to be installed at the patient's home in order to operate the system consists of the following: 1) A blood pressure meter, a weighing scale and a wearable actigraphic sensor, 2) a tablet PC with the ALADDIN software for: (a) administering the neuropsychological examination, (b) providing access to the ALADDIN social networking environment and the ALADDIN TV for additional educational, physical and cognitive exercising features, (c) generating manual warning to the clinician and 3) a network connection through which the collected data can be transmitted to the ALADDIN server, where they are stored, processed, analysed and displayed to the clinicians in a structured manner.

The clinicians' interface to the system is a web-based application, so they can access the system wherever they are through a web-browser. The home page of the clinician's application, as presented in Figure 4, provides them with access to all the functions and operations they can do through the system. They can view, sort and filter the list of their patients, or carers or fellow doctors and nursing staff; they can manage the questionnaires by adding or removing questions in a way tailored to the individual patient's and carer's profile; they can assign tasks to their patients / carers for the specific day or plan their tasks, e.g., for the week; they can check the individual recordings of their patients and their recorded measurements; they can manage the external services and select material appropriate for their patients, and they can see at a glance all the warnings that have been generated by the system, and sort them by patient name, carer name, date, type, importance, cause, etc. Therefore, the ALADDIN system is a useful tool for efficient patient management, providing effective follow-up and decision support capabilities to the treating clinicians and a feeling of reassurance to the carers.

3. Some concluding remarks from the ALADDIN experience

Standard telemedicine and home-care systems have been established and tested for a variety of chronic health conditions, and a significant number of high-tech products are now available in the market to support these implementations. Our experience, however, from implementing the ALADDIN project, has been that the most important requirement for home care systems dedicated to dementia management is simplicity. Systems of this kind have to be designed to be as simple and user-friendly as possible if they are to actually make the lives of the patients and the carers easier, instead of putting an additional burden on them. Low cost is the other most important requirement, especially in the current environment of the economic crisis. Home care solutions have to be first of all affordable by the users, and this parameter must be given a high priority by the developers when it comes to choosing between components, parts and devices that are necessary to build their systems. The implementation of fully automated systems is also an open question as regards the benefits to the users when compared to solutions that allow an increased level of self-involvement in the disease management process.

At the moment of preparation of this paper, ALADDIN system is being tested and evaluated in a pilot study conducted by 3 clinical sites in Spain, Greece and UK involving more than 30 patients. The results of the pilot operation are expected to provide an initial confirmation as regards the anticipated benefits of using the system, in a quantitative manner. While the anticipated benefits remain to be proven, it is worth sharing the feedback provided by our colleague in the project, Prof. Jahanshahi, who is in charge of the pilot running at the National Hospital of Neurology and Neurosurgery in London, in her own words:

[...] *We have all been amazed at how 'desperate' and stressed most of the carers are and feel we have opened up the door to an area of real need, which is not adequately covered by existing services as it lies in the no man's land between medical and social services* [...]

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A TAXONOMY OF AMBIENT ASSISTED LIVING (AAL) SELF-MANAGEMENT SYSTEMS

Peter Roelofsma[1]

Abstract/Summary

In this paper we will provide a taxonomy of AAL solutions for self-management of elderly who have or are at risk of having chronic diseases. The taxonomy is helpful for users searching the market for systems that could meet their needs. The taxonomy also provides a guideline for further innovation in existing or new systems. The taxonomy is based on a review of existing AAL projects in Europe and has been developed on the principles of Grounded Theory. The developed taxonomy consists of 10 dimensions. Five dimensions can be used as a quick scan for short descriptive system evaluations. The remaining five dimensions provide additional detailed system overview information. The main aim of the paper is to describe the five quick scan dimensions. The total set of dimensions will be briefly discussed. It is concluded that this AAL taxonomy should be used in the communication and dissemination of existing and new AAL systems. Without such a validated taxonomy the user is easily led into confusion or even under the illusion that a system will be effective while it is often unclear to what extent this expectation is realistic.

1. Introduction

Self-management of one's chronic condition(s) can play an important role in sustaining autonomy and wellbeing. In AAL several projects are developing ICT-based solutions to support self-management for older people. They consist of personally monitored and tailored programmes for training or daily activities.

An increasing amount of innovations are being introduced and many new systems are being developed in this domain. With the increase of applications of such systems it is becoming increasingly difficult for users to find the right system that fulfils their need. Also, for further innovation of existing and new systems it is often difficult to assess what the differences and similarities are between existing systems and what is needed for future development.

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The aim of this paper is to provide a solution for this problem by developing several dimensions for classifying AAL systems for self-management and prevention of chronic diseases.

Grounded Theory [1, 2] is applied to examine the set of existing AAL systems and to develop a set of classification dimensions for the AAL taxonomy. A grounded theory approach refers to category formation based on a data set that is split up into two parts. One part is examined inductively to create a set of categories, i.e. the set of dimensions for the AAL taxonomy. The second part of the data set is then used to test and validate the data set deductively from the first part. When a fit is found. the set of dimensions is assumed to be verified and validated.

2. Method

As a data set the AAL systems that were selected in the first AAL call were used. The following AAL projects were part of the examination: Happy Aging, HELP, HERA, HMFM, HOPE, IS-ACTIVE, PAMAP. REMOTE, RGS, ROSETTA, SOFTCARE, A2E2, AGNES, ALADIN, AMICA, BEDMOND, CAPMOUSE, CARE, CCE, DOMEO, eCAALYX, EMOTIONAAL, H@H [3,4].

The projects were randomly divided into two groups. The first group was used to inductively develop a set of dimensions, which was then validated on the second group. Starting with the first group, all available information on the projects was examined. Websites for all projects were examined and project descriptions were studied, and, where needed, contact was made with the corresponding project coordination team.

3. Results

Based on this data analysis, the first set of taxonomy categories was made. The set was fitted on the data of the second group. It appeared that the category dimensions of the first group adequately described the data in the second group.

Below follows a description of each of the resulting AAL Taxonomy dimensions.

Taxonomy for AAL self-management systems: 10 dimensions

1. *Subject Type*. The dimension *Subject type* refers to the target population group for which the system is primarily designed.
   Table 1 presents an overview of target groups of the examined AAL systems.

Table 1. Overview of specific target groups of AAL Systems

Dementia/Alzheimer's/Mild Cognitive Impairment	26%
Fall detection	17%
Specific Motor & Mobility Issues	17%
Increasing overall PA (Physical Activity/ADL)	13%
Medication and Supplies	13%
Lung Disease (COPD)	9%
Chronic Heart Failure (CHF)	4%

Most AAL systems were designed for a specific target group. 26% of the systems were developed for dementia problems, 17% for fall detection and 17% for specific motor and mobility issues. 13% were developed for supporting medication or other goods supplies. 9% were developed for COPD lung diseases and 4% for chronic heart failure. 13% of the system were not developed for a specific subgroup of elderly persons but for the general group, e.g., to support an increase in overall physical activity (PA).

In is interesting to note that it is often the case that the system description does not adequately mention the specific target groups and that further examination is often needed to find that information.

2. *Setting*. The dimension *Setting* in the taxonomy refers to the environment where the system is used. Systems can be used in several settings or only in a specific setting. This can be in or outside the home. They can be used in clinical and or non-clinical settings. Also they can be developed for use in urban city environments as well as specifically for rural environments. The dimension *Setting* is also often not adequately described in the existing documentation and it takes too much time in general to find the necessary exact information regarding this dimension of the taxonomy.

3. *Function types (causal variables).* This dimension refers to the type of content that the system has implemented to achieve its intended effects. In particular, it refers to the causal functional variables through which the system aims to enable increased the wellbeing and independence of the elderly. The following subsets were observed in the data:

   Dimension 3: AAL Content Function types:
   a. Monitoring
   b. Education/Training/Specific Feedback
   c. Memory Support
   d. Support ADL
   e. Motivation
   f. Therapy

Once again, the documentation for *Function types* was often inadequate and too much time was needed to achieve a quick oversight of this for many of the AAL systems.

4. *Measures (Effect Variables)*. This dimension refers to the measures that the system generates. These measures are used to assess the effect of the causal variables of the system. These measures are either self-report measures, like interviews, questionnaires or survey approaches; or they can be observation measures, like sensors for behavioural and/or physiological data.

   Again, here much can be gained from efficient documentation regarding this dimension, in particular with regard to the question of how the self-report measures are related to the behavioural measures.

5. *Cause-effect relation type*. This dimension refers to the existing evidence that using the system will produce the intended effect. More specifically, it addresses the reliability and validity of evidence-based relations between the cause and effect system variables.

   Most systems used small pilots and case-based reviews to validate the effect. However, it is well known that the validity of such approaches is very limited [6, 7]. A few systems use relational or quasi-experimental approaches, but these approaches also have crucial validity problems [6, 7]. It appeared that almost none of the systems used adequate validation approaches like randomised controlled trials, or experimental transfer studies using adequate subject samples to allow for sufficient statistical power to demonstrate evidence-based effects [6,7].

Further AAL Taxonomy dimensions. Five other dimensions were identified as providing important detailed information for system verification and validation. These are:

6. Theoretical basis of the system
7. System maintenance.
8. System documentation
9. Usability and ease of system training
10. System safety Issues.

These are mentioned only briefly here, but are described in more detail in a separate publication [5].

4. Discussion/conclusions

The purpose of this paper was to examine to what extent it would be possible to derive a set of dimensions that can be used to classify existing and new AAL systems. Such a systematic classification of AAL systems, also called a system taxonomy [8], is useful both for potential users and for researchers and developers. A set of AAL systems was examined using a grounded theory approach which appeared to be successful in deriving a taxonomy with 10 dimensions. Dimensions can be selected for a quick scan of a system, but also for more detailed system verification and validation.

From the results it appeared that system documentation often provides insufficient information regarding crucial issues of the AAL taxonomy. It is sometimes unclear for which specific subgroup(s) the system can be used and in which settings. Also the cause-effect relations of the system variables are often inadequately described. Most importantly, an overall lack of adequate description of evidence-based and validated system effectiveness is reported.

We conclude that there is a need for using the AAL taxonomy described in this paper. The taxonomy should not only be used for potential future users, but also in communication and dissemination between researchers and developers. Without such a validated taxonomy, system documentation can be confusing or unclear regarding evidence-based system expectations.

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AN INERTIAL SENSING SYSTEM FOR ADVANCED CHRONIC CONDITION MONITORING AND RISK PREVENTION

Raluca Marin-Perianu[1] and Paul Havinga[1]

Abstract

We present a person-centric healthcare solution for patients with chronic conditions based on the recent advances in wireless inertial sensing systems. Our solution emphasizes the role of the home as a care environment, by providing real-time support to patients in order to monitor, self-manage and improve their physical condition according to their specific situation.

1. Introduction

Within the Ambient Assisted Living (AAL) Joint Programme, the IS-ACTIVE project [3] is developing a person-centric healthcare solution for persons with chronic conditions - especially elderly people - based on the latest advances in the field of Wireless Sensor Networks (WSNs). WSNs provide distributed sensing and intelligent recognition of activities and situations, as well as simple and ubiquitous feedback modalities, thus taking complex computer interaction out of the loop and breaking the digital divide [1, 2]. The home becomes the main care environment, where the users can continuously monitor, self-manage and improve their physical condition according to their specific situation. The IS-ACTIVE consortium designs, builds and tests systems that can be bought and used by individuals, instead of being the property of healthcare institutions. IS-ACTIVE will allow the shift of medical device technology into the mainstream consumer electronics market. This implies that there is a strong focus towards ease of use, integration and pricing.

In this paper we describe the general architecture of the system, the functional overview including the wireless sensor platform with associated feedback modalities, an overview of the validation methods and results, and finally the conclusions.

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2. Architecture

Figure 1 presents the top-level view of the main architectural components taken into account by IS-ACTIVE. We distinguish the following important building blocks:

Wireless sensors networks (WSNs) - the core technology of IS-ACTIVE, creating a pervasive environment around the user:

- On-body sensors, such as inertial sensors (used for the analysis of user motions, activity monitoring and exercise coaching) and physiological sensors (used for checking the safety limits of the user's current condition).
  - The on-body sensors form the Body Sensor Network (BSN).
  - Infrastructure sensors, such as environmental sensors (used for signalling possible adverse environmental conditions with respect to the user's specific condition).
- Technology-aided objects (TAOs) – technology-enhanced daily objects (for indoor or outdoor use) that contribute to monitoring and assessing the physical training performance of patients. These are mainly graspable objects with which the users carry out training tasks at home and outdoors. Together, the on-body sensors and TAOs form the Extended Body Sensor Network (BSN+).
- Feedback devices – covering all user interaction aspects, providing the information sensed and processed by the WSN in a simple and appealing way to the user. The main objective here is to enhance the user's motivation for physical activity.

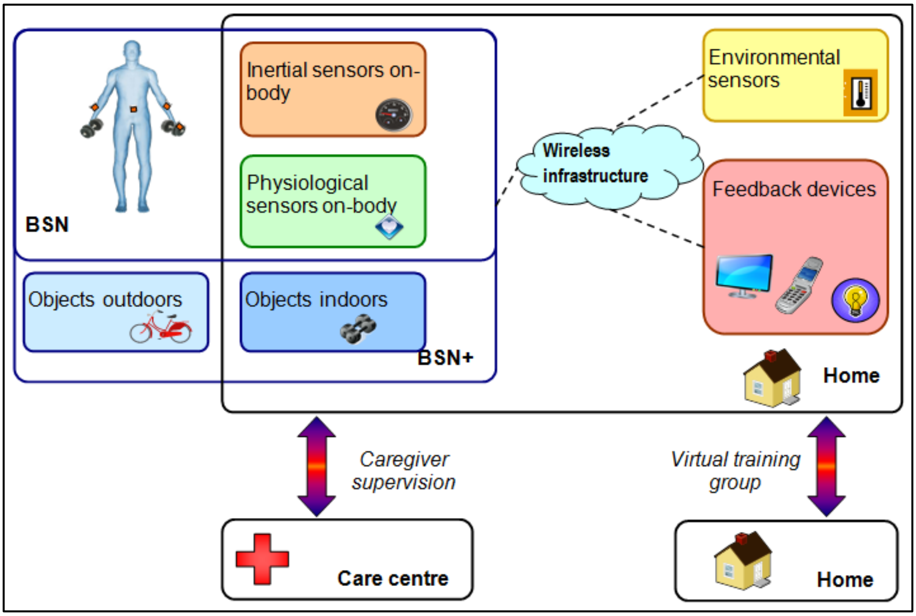

Figure 1. Block diagram of IS-ACTIVE system architecture

3. Functional overview

The IS-ACTIVE architecture supports two main lines of functionality:

- Long-term, daily physical activity monitoring and stimulation using wireless sensor networks and intuitive, light-based feedback devices. The system monitors the amount of activity, type of activity, distribution of activity (daily activity pattern), activity intensity and certain types of activities like walking. Patients receive feedback about their activity in order to improve their physical condition and quality of life.
- Physical exercises – training and coaching – specifically designed for COPD patients, using collaborative intelligence of wireless sensors and a stimulating gaming interface. Interaction and entertaining feedback are essential aspects for convincing patients to perform physical exercises that can be perceived as extremely tiring and tedious in their condition. Patients receive feedback about the right execution of the exercise and safety.

In the following, we describe the wireless sensor node platform, the feedback modalities for the activity monitoring, and the system for exercise coaching.

3.1 Wireless sensor node platform

The IS-ACTIVE hardware platform – ProMove [4] – is a highly miniaturized inertial sensor node that captures and communicates wireless full 3-D motion and orientation information. It combines the latest advances in MEMS sensor design and low-power wireless communication. Featuring a suite of modern inertial and magnetic sensors, a dedicated microcontroller for application-specific software, and a separate System-on-Chip (SoC) solution for wireless networking, ProMove is a powerful, versatile platform for motion-sensing applications.

Figure 2 shows a version of the latest ProMove prototype, called ProMove 3D, which the patient has to wear on his/her hip. A dedicated casing has been designed and developed for wearability, with a special clip that automatically switches on the node.
The ProMove platform uses both lines of functionality of the IS-ACTIVE system, including activity monitoring of patients and motion detection for physical exercises.

Figure 2. The wireless sensing platform ProMove-3D

3.2 Feedback devices for activity monitoring

The aim of these devices is to manage high-level feedback for the user in three different ways. Firstly, they are meant to communicate the information sent by the sensor system to the user in the form of assessed information about the physical status or training program history. Secondly, they are intended to serve as a communication bridge between caregivers and the patient. Finally, they should enhance motivation for physical activity.

Feedback can be given when the patient is either inside or outside the home. We have chosen two such devices that together meet the requirements for both cases (see Figure 3):

1. Smartphone. Smartphones can be used to access and facilitate the communication between patients, caregivers and friends remotely (outdoors and indoors), while providing feedback about physical status. A smartphone can be carried around by the patient and it is thus suitable for giving feedback on activities while the patient is on the move.
2. Tablet. This is an integrated central device in people's daily life and patients are likely to be familiar with it. It offers an intuitive interface, making it a good means to provide suitable feedback for in-home usage.

In the IS-ACTIVE project, we have designed user-friendly interfaces for both mobile phones and photo frames that have been tested for usability and acceptance by COPD patients during the initial experiments.

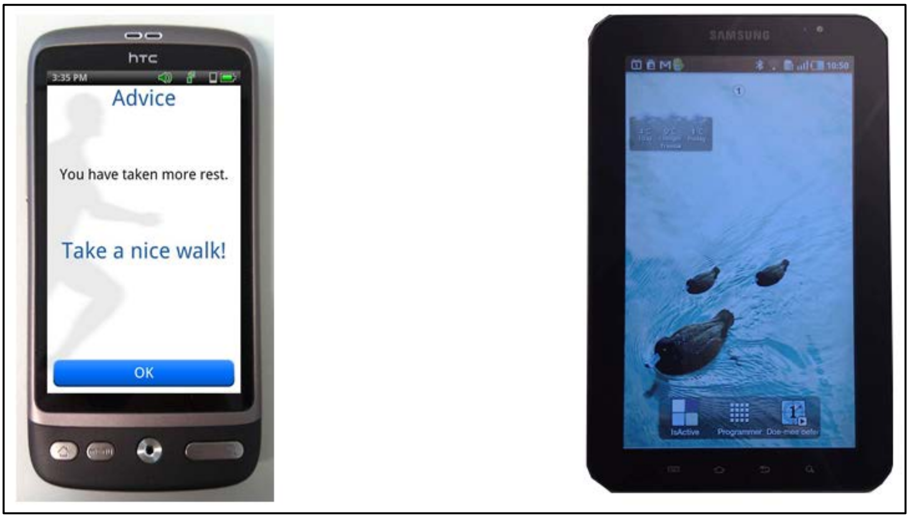

Figure 3. The smartphone and tablet feedback devices

3.3. Exercise coaching

The Orange Submarine game is part of the exercise coaching program of IS-ACTIVE, where patients are encouraged to do more physical activity through an interactive exercise. The development includes the design of a sensorized dumbbell and the design of the game.

A sensorized dumbbell (see Figure 4) is used to create a sensor-enhanced exercising experience for the user. The dumbbell contains a ProMove sensor node that detects the direction of the vertical motion and a Nonin pulse oximeter that reads the oxygen saturation and heart rate levels. The motion data and the oxygen saturation and heart rate values are sent wirelessly by the ProMove sensor node embedded in the dumbbell to a computer that runs the game. This data is used as input for the game.

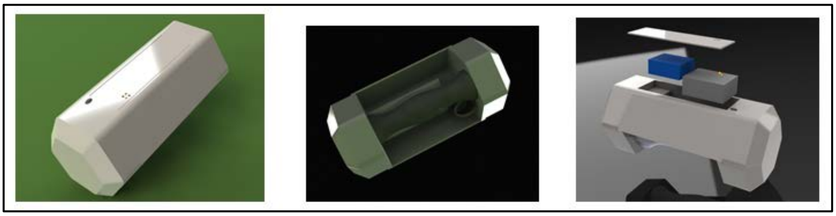

Figure 4. The design of the sensorized dumbbell

The game consists of a submarine, which moves to the right at a constant speed (see Figure 5). The player controls the vertical position of the submarine by moving the dumbbell up and down. A sine wave of bubbles is displayed on the bottom of the sea. The user has to catch bubbles by moving the dumbbell up and down, which translates on the screen into the movement of the submarine. The score shown in the top right corner is based on the number of bubbles caught by the submarine. The heart rate and oxygen saturation levels are shown in real-time during game play, in the upper right corner of the screen. The game stops when the oxygen saturation or heart rate exceeds the patient's threshold and shows a pop-up warning message instructing the patient to rest.

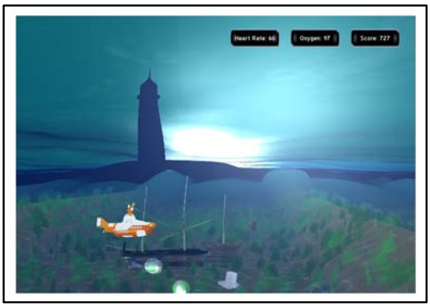

Figure 5. Screenshot of the Orange Submarine game

4. Validation

The validation of project results will be a two-step iterative process: the initial experiments and the field trials. The initial experiments were conducted as lab trials with 26 COPD patients in three countries: the Netherlands, Romania and Norway. These experiments provided valuable feedback on possible issues and refinement points in the hardware and software design. The evaluation has focused on usability and user acceptance of the prototypes developed - the smartphone and tablet feedback devices and the ProMove sensor node. The System Usability Scale (SUS) was used for giving a general and high-level view on usability and the Unified Theory of Acceptance and Use of Technology (UTAUT) were selected to assess the intention to use and usage behaviour.

The results look promising for the technologies and services evaluated. For the smartphone feedback device, the usability scored high, well above the average. The score could be even higher when we adapt the learnability aspects of the system. Patients had a moderate to high intention to use the system in the future. The Romanian participants considered the PDA feedback device useful for risk prevention, where information regarding heart rate and oxygen saturation could be used. For the tablet feedback device, the intention to use was higher for the Norwegian participants. The new technology was not easily accepted by the AAL age group (some participants were almost 90 years old), but also not rejected.

As refinement points to the tested system, we mention the following:

- Develop clear manuals for the patients to improve learnability
- Include information about heart rate and oxygen saturation for risk prevention
- Look-and-feel improvements

Using this feedback, improved prototypes will be tested in the field trials, where patients will try all the components of the IS-ACTIVE system in their home environment.

5. Conclusions

This paper presented the IS-ACTIVE system for monitoring, coaching, and stimulating patients with chronic conditions. The system is composed of a Wireless Sensor Network that monitors the activity of patients, technology-aided objects which contribute to monitoring and assessing the physical training performance of patients, and feedback devices, covering all user interaction aspects. The system was tested and evaluated in the initial experiments with COPD patients and showed promising results. The refined system will be tested in field trials, where patients will try the IS-ACTIVE system in their home environment.

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THE PAMAP SYSTEM: A PHYSICAL ACTIVITY MONITORING AND TUTORING ICT SOLUTION

Fradet L.[1], Bleser G.[2], Lamprinos I.[3], Carré F.[4], Stricker D.[2], Marin F.[1]

Abstract

Physical activity provides many physiological benefits. It reduces the risk of disease outcomes and is the basis for proper rehabilitation in case of or after a severe disease. The nature of physical activity can be categorized as either aerobic activity or strength exercises. Balanced activity of both types is important, especially to the elderly population. The present article introduces a personalized, home-based physical activity trainer especially suited for elderly people. The system guides a user at home through a personalized exercise programme. By means of a wearable sensor network it enables the user's movements to be captured. These are then evaluated by comparing them with prescribed exercises, taking both exercise load and technique into account. The results are translated into appropriate feedback in order to assist the correct exercise execution.

1. Introduction

Physical activity provides many physiological benefits, reduces the risk of disease outcomes, and generates important psychological gains [1]. The nature of physical activity can be categorized as aerobic activity, promoting cardiovascular fitness, and strength exercises, promoting musculoskeletal fitness. Particularly in frail populations, balanced activity of both types is important for keeping functional independence [1]. It is hence essential to promote the practice of physical activity especially at home since it has been shown that adherence to exercise is greater when performed at home than when performed in centres [2]. However, this physical activity has to be supervised in order to improve physical fitness whilst minimizing the risk of injuries due to inadequate physical activity practices [3]. For that purpose the supervision of physical activity has to be achieved whilst providing feedback and motivational elements to the

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user regarding his activity. This preserves or increases motivation and programme adherence.

The supervision of physical activity at home has until now mainly been related to rehabilitation follow-up. Information and Communication Technologies (ICT) have been used for that purpose by providing rehabilitation services at home over telecommunication networks and the Internet. This constitutes the recent field of telerehabilitation [4]. However, only a few of these projects have tried to elaborate a more complete approach of services including monitoring of physical activity, a wellness diary, mentoring sessions, and a web-portal to facilitate personal goal-setting and to assess the progress of each patient in the programme [5]. Additionally, most often these telerehabilitation projects focus on a specific aspect of physical activity related to a special disease or pathology and do not consider physical activity as a whole.

The aim of the present project, PAMAP (AAL-2008-1-162), is to promote physical activity especially in the elderly population by creating a platform that can supervise, motivate and help the practice of physical activity. This platform can also be used in support of home-based physical rehabilitation. The present article focuses on the physical activity monitoring aspects. As previously mentioned, two different categories of physical activity are recommended: aerobic and strength training activities. Recently developed methods based on inertial sensors have been proposed to monitor aerobic activities [6, 7]. With such methods it is possible to control whether the F.I.T.T. (Frequency, Intensity, Type, and Time of training) principles of training [8] are well respected by the subject. During strength training, to our knowledge, no appropriate method for monitoring has been proposed. Current video games includes feedback provided by accelerometers or image processing in order for users to follow some fitness exercises, but only a few parameters are taken into account and the proposed methods remain undocumented. In addition, studies have shown that strength training can result in injuries when performed with the wrong technique [8]. This risk and its consequences increase in populations that are not used to physical activity practice and are physically diminished, such as elderly or pathological individuals. Therefore, an appropriate monitoring of strength training has to be proposed.

The present work presents the PAMAP system, which enables physical activity monitoring, describing the design and implementation of the respective hardware and software infrastructures.

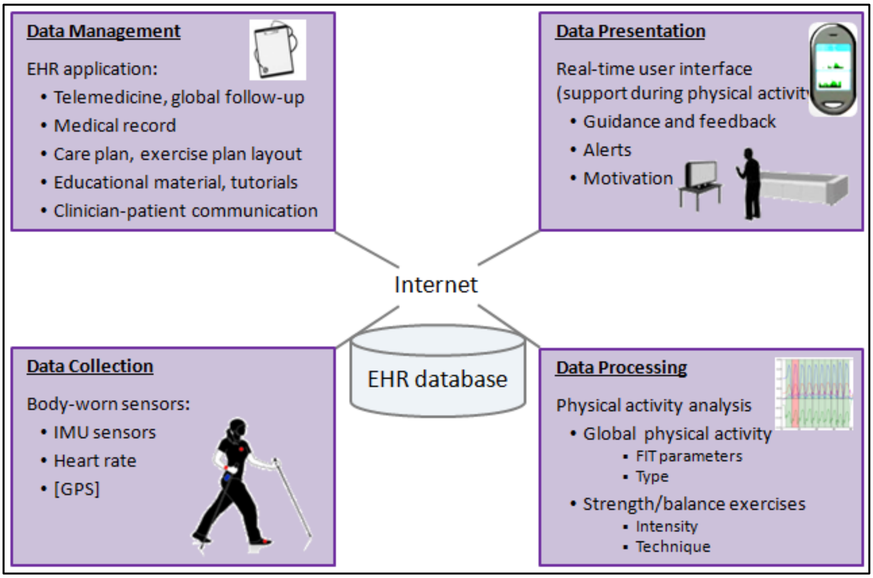

Figure 1: Complete system overview. The upper components represent the part of the system that the user interacts with; the lower components encapsulate the underlying technology.

2. PAMAP System Overview

The overall PAMAP system is modular and flexible: As illustrated in Figure 1, it is composed of four self-contained principal components that communicate over a network using standard as well as customized protocols. The modular design makes it possible to exchange the modules independently to easily customize the system for the needs of the individual user.

The data management component is based on a web application for collecting and managing all relevant information in an electronic health record (EHR). Apart from physical activity data, this web application also includes a comprehensive summary of a medical record, a rehabilitation plan management module, e.g., for outlining an individualized training program that can be exported to the trainer software, and a health status survey module. This component extends the system for use as a remote patient monitoring system. Health-care professionals are enabled to maintain an EHR of their patients and to establish and follow up personalized rehabilitation plans. In turn, the patients, who can gain access via the web or an interactive TV (i-TV) interface, are provided with the means to stay in touch with their health-care professionals. The i-TV solution is used to increase acceptance and ease learning amongst elderly users, who are generally not very familiar with computers.

The data presentation component is a web application for physical activity visualization, guidance and feedback. Individual user interfaces have been developed for presenting the different dimensions of physical activity. Particular effort has been spent in developing the trainer mode. Here, the user is instructed how to prepare for and perform an individualized training session. During training, he receives audio and visual feedback on the way he executes the exercises. After each exercise, the user gets feedback on the overall quality of execution. This enables self-monitoring and can motivate him to improve his performance during the next session.

The data collection component is based on a network of (wireless) sensors and a mobile processing unit worn by the user in order to measure his motions and vital signs. The complete set-up comprises up to ten miniature inertial sensors and complementary sensors, such as a heart rate monitor. However, the system is set up in a modular way, so that with a subset of sensors, a subset of physical activity parameters can be controlled.

Pre-processing includes correction, filtering and synchronization of the raw sensor data, as well as the derivation of higher-level information, for instance, the body posture in terms of joint angles. The data processing component consists of software for analysing and characterizing the physical activity of the user based on the pre-processed data. Several individual algorithms have been developed to enable sophisticated analysis.

3. Physical activity monitoring

As previously mentioned, the PAMAP system aims to promote and supervise the physical activity practice of the elderly. To do so, physical activity has to be monitored. A typical physical activity programme consists of both resistance/stretching exercises and aerobic exercises, whereas rehabilitation support includes both a tutorial and an assessment aspect. Consequently, different aspects of monitoring have to be developed.

3.1 Global activity monitoring

In order to control aerobic training, assessment is the most important aspect. For this assessment, four global parameters have to be defined: the Frequency, Intensity, Type, and Time (the so-called FITT principle) of physical activity. While the parameters frequency and time (e.g. duration) are rather easy to obtain, the challenge remains to develop a methodology to estimate – based on the available sensor measurements – the parameters type and intensity automatically, precisely, and reliably. In addition, the major constraint is to use a limited number of sensors and relaxed requirements for calibration and fixation, since global activity should be monitored over a long period of time.

The global activity monitoring has then to identify lying, sitting, and standing postures as well as traditionally recommended aerobic activities (walking, running, cycling and

Nordic walking) with a high reliability, and to classify other, miscellaneous activities according to their intensity level. As for all other activities, the system should classify them as activities requiring light, moderate or vigorous effort. These activity intensity classes are defined by the energy expended while performing an activity: light intensity (< 3 METs – MET: Metabolic Equivalent of Task), moderate intensity (3-6 METs) and vigorous intensity (> 6 METs). To determine the intensity level of a certain activity, a compendium of physical activities is used. This compendium contains MET intensities for more than 600 specific activities, and can thus be used as a reference to determine the intensity level of certain activities.

During physical activity, the subject being monitored wears inertial sensors on his/her foot, chest and wrist, together with a heart rate monitor, all connected to a data recording unit. The sensors are synchronized by the data collection software. From the collected data, signal-oriented (in time- and frequency-domain) features are extracted and selected, mainly from acceleration and heart rate data. These features are used to construct and train a decision tree: the decision nodes contain selected features, and the leaf nodes represent the activity and intensity classes. This decision tree is used to define which physical activity or posture is being taken by the subject and at which intensity the activity is performed. The methodology is detailed in other papers [9].

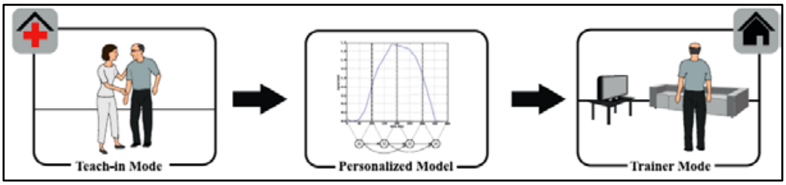

Figure 2. Overview of the personalized exercise trainer use case. During the guided teach-in phase a reference motion is recorded. Based on the captured motion data a personalized model is generated and then used in the trainer mode at home as evaluation reference.

3.2 Strength exercise monitoring

The physical activity monitoring has then to help the user to follow a physical activity programme and to perform the recommended strength exercises correctly. Within this context, data collection, processing and presentation are detailed, putting emphasis on two major system aspects: (a) Usability for the elderly: as argued previously, physical activity and particularly strength training have to be promoted within the elderly population but incorrectly executed exercises could cause more damage than benefit; (b) Personalization: personalized training implies respecting the limited mobility of the individual subject during the training and automatic exercise evaluation. This is particularly important for the elderly population, where a higher percentage of pathologies and physical intrinsic limitation are to be expected.

The aim of the exercise trainer is to guide a user through an individualized training session consisting of preparation, warm-up, work, and cool-down phase, to accurately evaluate the performed movements and, based on this, to provide valuable feedback in real-time. The user is guided to perform the training correctly. However, what is correct depends on the limitations and goals of the user. Hence, personalized exercise training support is required (Figure 2). The proposed solution is to define a personalized reference for evaluation within a supervised training session. During this session, the PAMAP system is used in a teach-in mode. While the patient is shown how to perform the exercises according to his or her special needs by the physiotherapist, inertial data are recorded and pre-processed. The estimated motion sequences are further processed to derive a personalized model for each exercise. At home, the patient uses the PAMAP system in the trainer mode. In this mode, the performed motion is evaluated by comparing it to the stored reference models. The evaluation results are then translated into helpful audio and visual feedback for the user. The different parameters that are compared are detailed in the following.

According to strength training literature, during exercise, the intensity and the technique of the exercise have to be checked to ensure safety but also to ensure that the muscles that work are the correct ones. The load of the exercise, the muscles that work but also the posture adopted during the exercise then have to be evaluated. The algorithm used to compare these parameters to those of the movement of reference is detailed in Figure 3.

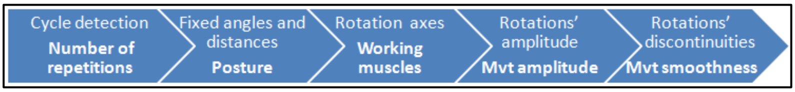

Figure 3. Algorithm for the movement evaluation.

4. User Interface

One of the most difficult problems in adopting technology is the use of interfaces that are often not well suited for elderly users. Especially, the aspect of technology acceptance needs to be addressed. The technology should aim to be less noticeable than traditional hardware and better integrated with the lifestyle of the elderly [10]. Moreover, the interface should be developed for elderly people with little or no computer experience. Currently, the set-up for the elderly makes use of a television, so the need to learn a new interface is negligible, as the user will work with an already familiar interface. Furthermore, the user is unaware of any underlying software or hardware details within the system, as the monitor visually and behaviourally represents a television, with the remote control still being the primary input device.

Besides the wearable sensor network, the graphical user interface is the main component with which the user comes into contact. Modern interface design requires the use of memory and sight, both faculties that decrease with age [11]. Visual changes among ageing adults include problems with reading speed, seeing in dim light, reading small print, and locating objects. For the current system the symbols were designed to be simple and large. A large and clear font was also used in the application and only the most necessary information for use is displayed on the screen (see Figure 4). To support the text information presented, a speech output has been introduced for limited vision users.

An overview of the user interface design elements is shown in Figure 4. These are the main elements to help guide the user through various types of strength exercises. The user's movements are visualized by means of a volumetric virtual avatar. The progress bar indicates the current phase of the training session, including warm-up, cool-down and work phase. The remaining elements are dedicated to the current exercise within the work phase: tutorial images, the weights to use, the duration of a break, and the number of repetitions and sets to do and already performed support the user while exercising. With this equipment, the user's heart rate can also be visualized.

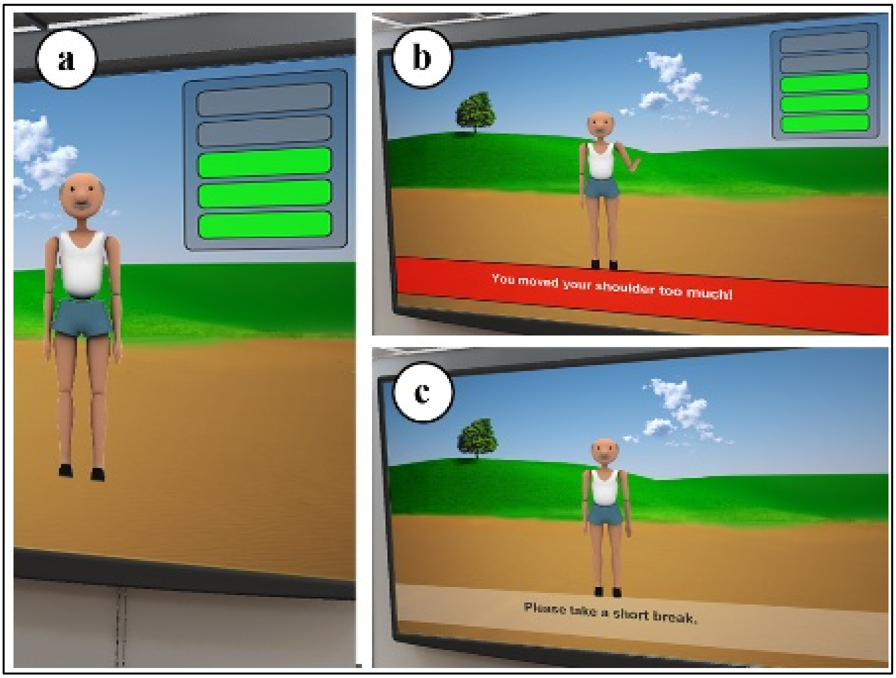

Figure 4. Interfaces during an exercise: Besides the number of repetitions (a), the system provides feedback in case of wrong execution (b), and protects against overexertion (c).

5. Conclusion

The PAMAP system is a powerful platform for supporting the practice of physical activity in both clinical settings and out-of-hospital environments. In particular, the PAMAP system proposes to help the user to follow his or her exercise programme at home, to perform the exercises correctly, and to stay involved in the practice of physical activity. Overviews of the overall system and its functionalities have been presented in the present article. The article then detailed the special use case of home-based exercise training for both prevention and rehabilitation.

Currently, a demonstrator of the PAMAP system is available and evaluations by end-users under clinical supervision are in progress.

Acknowledgements

This work has been performed within the PAMAP project funded under the AAL Joint Programme (AAL-2008-1). The authors would like to thank the project partners and the EU and national funding authorities for the financial support. For more information, please visit the website www.pamap.org.

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USER ACCEPTANCE OF VIRTUAL COACHES IN AAL TO MOTIVATE ELDERLY FOR PHYSICAL AND SOCIAL ACTIVITY

Peter Roelofsma[1]

Abstract/Summary

This paper presents the results of an acceptance study that implements virtual coaches in an AAL system. The virtual coaches are connected to activity sensors that the elderly wear during the day. The integrated system monitors elderly persons and motivates them to stay physically and socially active. A user acceptance study of the virtual coaches was performed with 70 elderly persons in the age range of 65-77. The results indicated a high overall acceptance of the virtual coach by the elderly users. It is concluded that combining virtual coaches in AAL systems is a promising approach for motivating the elderly to use the AAL system to stay physically and socially active.

1. Introduction

The purpose of this paper is to describe the user acceptance of virtual coaches that are used in an Ambient Assisted Living project where a system is being developed that motivates elderly persons to take sufficient physical and social activity. The project is designed within a consortium of research institutions, end-user health care organizations, building co-operatives and SMEs. The project is part of a larger project on 'Healthy cities and high service neighbourhoods'. The system is being tested and deployed within real life settings in Europe. A first version of the system will be installed in 120 housing units built for elderly people. The programme has been funded by European and national grants.

The programme offers support on multiple levels through providing an avatar-based coach embedded in the physical environment of the home. The virtual coach teaches the elderly to use the new technology and motivates them to stay active and connected with people. It also supports them in information processing about social and care services and activities within the community. The virtual coach provides prompts and nudges to guide the elderly from moment to moment, in order to help them to improve their social network. In addition, the virtual coach guides the elderly through a behavioural enrichment programme based on implicit and intentional motivational

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theory to motivate them to be more active. Bio- and ambient sensors are connected to the system, providing input for real time feedback from the virtual coach to the elderly.

This project combines virtual coaching with online social networking to prevent and overcome inactivity in Europe's ageing populations. The goal of the project is to develop an easy to use and expandable IT solution embedded in the home environment that helps people connect with others in their existing social network, meet new people and remain active throughout the day. End-user care organizations will offer the system to their residents. The 3D virtual coaching system is being developed based on a user-centred design approach that includes an iterative process of user involvement. The virtual coaches are specifically being developed to engage elders for long, enduring social emotional relationships. The coach visits users throughout their day from when they wake to when they go to sleep and presents messages and other mediated communication from people in the social network, both the personal and the professional care network.

A crucial element of the system is the use of virtual coaches. The coaches were developed in earlier co-creation focus group sessions using qualitative data analysis. The research focus in this paper is to test the outcome with a quantitative user acceptance study.

2. Method

70 elderly persons, 35 men and 35 women in the age range of 65-77 years were required to participate in an interactive digital video task with two virtual coaches. The system was explained to the elderly and they were required to watch digital videos of the coaches. Then they were required to answer a set of questions. Pictures of the coaches Peter and Anna are presented in the figure below. User acceptance was measured using acceptance items based on Thorson and Rodgers [1] and Jin [2].

Example items are:

1. "I would tell my friends about Anna".
2. "Anna makes me feel comfortable, as if I were with a friend".
3. "I think that Anna could be a friend of mine".
4. "Anna could provide me with the help I might need when becoming more active".
5. "Having Anna at home could help me maintain and improve my social network".
6. "I enjoy having Anna around".
7. "I want to use the virtual coaches more often".

Figure 1. The system's male and female virtual coaches, Peter and Anna.

3. Results

Results of the responses to the questions are presented in the table below. As can be seen in the table, the overall acceptance of the coaches is very high. Most subjects enjoy having the coach around (84%), and would tell their friends about the coach (81%). In particular, they could envision the coach helping them to be more active (77%) and to improve their social network (71%). 71% of the elderly wanted to use the coach more often. Also they could envision the coach being their personal friend (83%).

Table 1. Summary of results

	Yes
I would tell my friends about Anna	81%
Anna makes me feel comfortable, as if I were with a friend	83%
I think that Anna could be a friend of mine	71%
Anna could provide me with the help I might need when becoming more active.	77%
Having Anna at home could help me maintain and improve my social network	71%
I enjoy having Anna around	84%
I want to use the virtual coaches more often	71%

4. Discussion/conclusions

While social networking offers new ways to overcome physical and social inactivity and loneliness, it is also a new and sometimes intimidating way for elders to connect. The platform is therefore designed for usability and acceptance through a co-creation design process developed in related projects. To inform the design of the system, elders participated in the design process. Elders participated in focus groups, interviews and tests of early versions of the platform in several European centres. Quantitative usability and acceptance studies of the system were carried out in this study. The results indicate a high rate of acceptance of the virtual coaches. The pilot tests conducted with elderly persons yielded promising results. Based on the results of the pilot tests, we conclude that combining virtual coaching with AAL systems is a promising way to help elders stay physically and socially active and sustain social networks.

Between one-third and one-half of older Europeans suffer from insufficient physical and social activity. As a result, many elderly suffer from mild or severe loneliness. The problems are linked to low quality of life and early morbidity, as lonely people exhibit poor health behaviour, excessive stress reactivity, and inadequate or inefficient physiological repair and maintenance processes. In the management of chronic disease in elderly patients, it is crucial to prevent and overcome physical and social inactivity.

While a variety of face-to-face interventions exist to combat different forms and causes, these programmes typically rely upon a large staff of healthcare workers to deliver services. The advent of the social web presents new opportunities to design technological solutions to target loneliness in elders. Insights from social psychology, gerontology and communication science can be adapted to create technologies that help people foster and maintain hybrid online/offline relationships.

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METHODOLOGICAL PERSPECTIVE: SYSTEM VISIONING FOR THE FUTURE OF WELLBEING & CARE

Prof. Dr. Eckehard Fozzy Moritz[1]

Abstract

In this paper the idea and methodology of system visioning as an important activity in the early stages of innovation projects is introduced, and illustrated in two examples from the field of wellbeing and care. It is suggested that this approach will be applied in more projects with a high degree of socio-technical innovation.

1. Background and objectives

The topics and claims condensed in the title might almost appear to justify a book, or at least a lengthy paper. However, the format of this documentation allows nothing anywhere near this scope. In the following, I will therefore resort to combining compact reasoning and some illustrative examples, hoping the reader will forgive the lack of formal foundation.

The story starts with the role of innovation: innovation is THE means to help shape the future – be it the future of mobility, of housing, or, certainly, of wellbeing and care. So far few will disagree. However, it is funny to see what usually happens next in innovation: companies will look for business niches, like food additives with health promises. Inventors will build prototypes to demonstrate some ideas they have thought of, like a rowing bicycle. Scientists will offer analytical models and demand evidence-based developments and hence evaluations: low intensity cardio exercise in a group can be designed and evaluated, entertaining movement stations in public space cannot really. And EU and national sponsors will be funding projects demanding scientific results, economic effects, and use value for people, at the same time, and all in a risky environment. The topic of the conference, AAL, is the best of examples.

Well, this is all more or less good, but in the wake of all these activities one important question is hardly really addressed: How actually do we want the future to look? More explicitly, what do we mean and want if we say wellbeing and care? And what do we

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want it to be like in the future, our future? Only on the basis of such a discourse can we really give orientation and the desired direction to innovation efforts.

Be sure, all innovation protagonists are shaping future to some degree – whether they intend to or not: the future will happen anyway, whatever we do (or don´t do) about it. And we can do a lot of different things: All readers who have ever attended a creativity workshop will remember that it is all too easy to generate dozens of ideas in a certain field without too much effort, really. No, it is definitely not ideas that are lacking in order to realize innovation. It is much more trust, spirit and perseverance; it is dedication and fantasy; it is the right people with the right resources at the right place in space and time. And, coming back to the topic of this paper, it is inspiration and orientation: How do we want the future to be? And which innovations become possible if we utilize new enablers like technologies and materials to realize the future we want? System Visioning is an approach, as part of the holistic innovation methodology [1] that intends to answer these questions. In the following, this approach will be introduced and illustrated in a few use cases related to the topic of wellness and care.

2. System Visioning – giving context and direction to innovation

If you wanted a definition of system visioning, it would sound like this: "System Visioning is an approach to preconceive and conceptualize a potentially useful system perspective of a feasible, plausible and desirable future in a pre-determined innovation field!" As this may not be too helpful yet, let me explain how it works:

- First, we **identify and circumscribe an innovation field** (wellbeing) and find out which functionalities, practical (movement, stress relief), and emotional (entertainment, immersion), are to be performed in that field; that is, need to be realized through innovations later on.
- Then we determine which **boundary conditions** need to be taken into account in realizing and embedding innovations (demographic change, self-responsibility for health, …), and which innovation enablers we do and will have at hand to realize innovations (cheap sensor-actor systems, virtual games, …).
- On that basis we preconceive, in a sort of "visionary design", possible, plausible, and desirable **elements of the future** in this field.
- These elements are then condensed and focused in a **system vision** of the future in the innovation field at stake.

The overall process is depicted in Fig. 1.

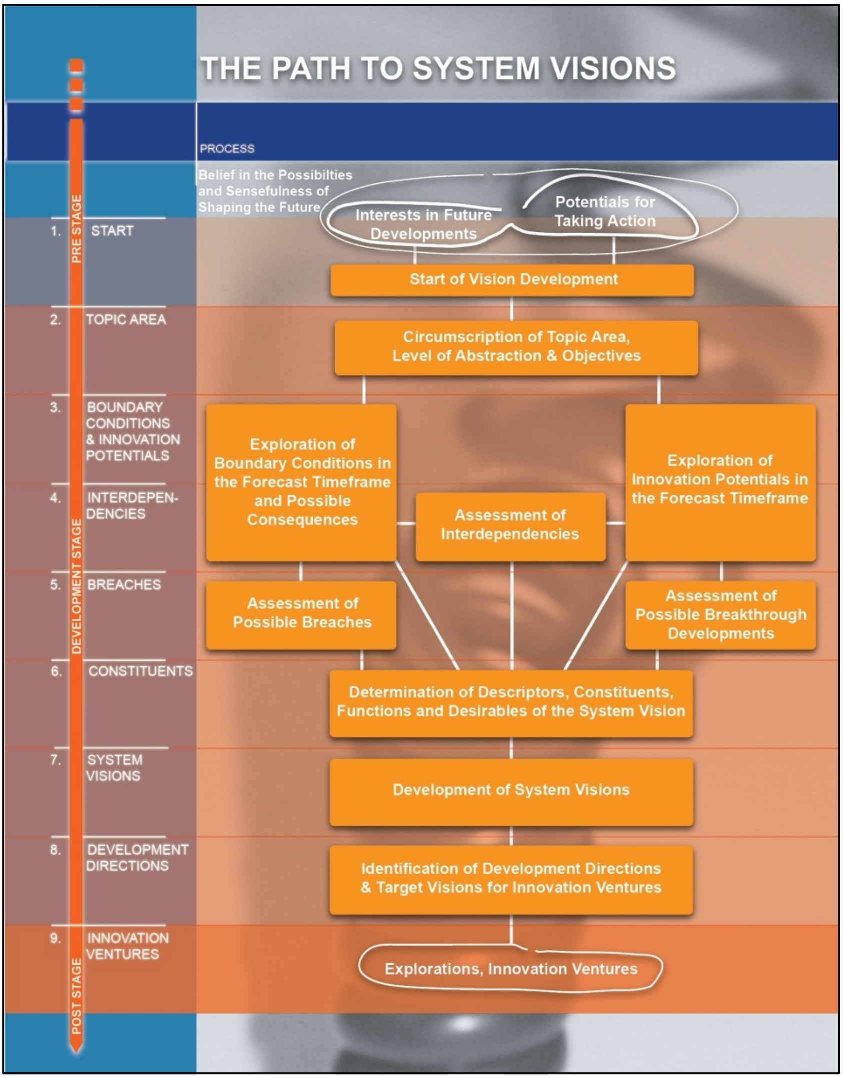

Figure 1. The process of system visioning

What is all of this good for? The basic advantages of system visioning are:

- It gives orientation and coherence in determining and coordinating specific innovation efforts/projects in a certain field.
- It prepares the way for the development of system solutions, and in general for systemic thinking, development, and action.
- It allows us to identify break-through developments through retropolation (one main and important advantage as opposed to the scenario technique).

- It guides, fosters and enhances collaborative work between people from different fields such as technology, science, and business, and the integration of end-users.

3. System Visioning – one example for "giving orientation and direction for innovation efforts"

Fig. 2 shows an example of systemic visioning in the innovation field of "health-enhancing design of office workplaces". Following the process outlined above, we had been focussing on the identification of rather short-term innovation opportunities in this field, nevertheless offering a systemic overview and a broad range of perspectives for action.

The first core challenge in any such system layout is the identification of a good structure for the illustration. Starting with the human being, we have put more physical anchor points for innovative solutions on the upper half, and more organizational ones on the lower half of the elliptic shape. Thereby we could arrange innovation topics that directly relate to an anchor at the outside, and those with interrelation with many anchors in the inside. The innovation topics are then named and briefly described with respect to "What do we need to realize?" and "How can we go about?" in order to give a more concrete understanding and orientation for future innovators.

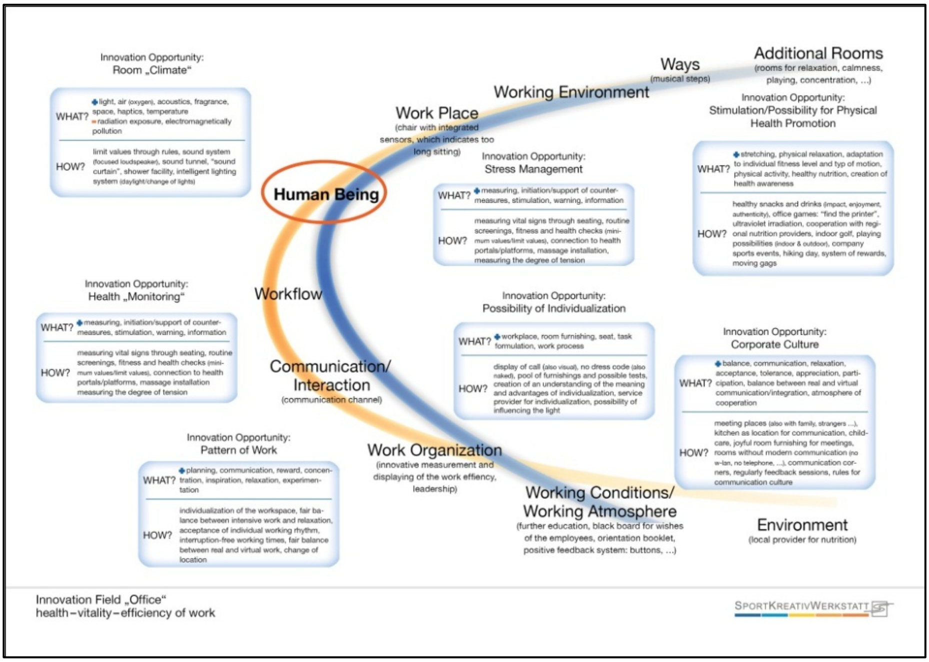

Figure 2. Innovation opportunities for a "healthy office"

4. System Visioning – one example for “systemic thinking and development in innovation”

Fig. 3 shows a much more concrete application of system visioning: The development of a system solution, as part of our work in the European AAL-project “SI-Screen Elisa” (http://www.si-screen.eu/).

In this project, the target vision has been determined as “a new economically, socially and culturally sustainable social interaction tool that enables elderly people to easily stay or get in touch with existing and new people of interest and which helps to find and participate in accessible local activity, health and wellbeing offers”. While still concentrating on some innovative technologies and features with respect to individual product offers, the eventual use value, acceptance, and integration of our solutions depend greatly on the degree of embedding, that is, systemic thinking and system development. In Fig. 3 the project team has therefore combined the depiction of the hardware, functionalities, and use cases: The social integration layer is taking all burdens regarding technologies and channels away from the user. The use cases of the overall system – which should be available at home, on tour and in a public or semi-public space - help to differentiate and yet consider the adaptation of functions and hardware solutions and the integration of related services.

Figure 3. A system solution for elderlies´ communication, developed in an AAL project

5. Final conclusions and recommendations

How can this approach be of benefit for future AAL projects? Our related recommendations can be summarized as follows:

- As system visioning is extremely helpful and increases success and efficiency especially in radical innovation ventures, we suggest that it may become a work package in the early stages of all larger, complex innovation projects aiming at a high degree of innovation.
- To help such projects in the context of AAL, and also the identification of future AAL topics, it will make sense to develop a large integrated future system vision for the health, wellbeing, and quality of life of European citizens, as a reference for all interested projects and institutions.

References

[1] Moritz, E.F. (2009) *Holistische Innovation*. Berlin: Springer- Verlag.

TRACK B RATIONALE

Social Interaction[1]

The focus of this track will be on projects funded under the second Call in the AAL JP on Social Interaction and other thematically related projects on the European and national levels. The aim of the track is to bring the projects together, discuss relevant research findings and the solutions which could be developed from them, exchange experiences regarding success factors and problems and to learn from each other. Specific sessions on business opportunities and ethical issues as well as issues regarding end-user involvement will be organised.

General aspects to be included in the Track B are:

AAL projects that produce solutions which are adaptable over the life course to benefit people as they grow older. The track will also address foresight issues since the lives of older persons will be subject to change, as society is subject to continual change. What should AAL be considering in this respect e.g. the needs of those in rural areas compared to cities might change in the future?

Social connectivity is about the subjective awareness of being in close interpersonal, meaningful and positive social relationships and contexts. It is affected by the quality, frequency, diversity and reciprocity of contacts as well as the possibilities and opportunities for establishing them.

Older persons are no different from any other demographic group and want to perform meaningful activities, to have fun and to experience satisfaction when learning new things. Many older persons have valuable resources (e.g. life experience, creative skills), and can significantly contribute to the society. These resources could be used to support others to stay socially active and to promote intergenerational relationships. Research has shown that, when embedded in active social networks, people tend to enjoy better physical and mental health.

[1] AAL Forum 2011, OnSite Guide and Programme

Session B1 – Social Interaction: Focus on Gender Differences and Rural/Urban Areas

End-users' desires, wishes and needs regarding social interaction may be very different. Men and women may have very different expectations in terms of useful solutions as they grow older. An example may be how the way they used to live influences their present expectations. Whether they live in a rural or an urban area may also play a role in influencing their expectations . Do these differences have a potential impact on the business plan for future service implementations?

Session B2 - Social Interaction – Focus on Social Community Networks and ICT-based Services

The session will be organised around the following questions:

- What is the observed behaviour of older persons regarding social networks and ICT-based services?
- What assumptions do and did projects have regarding the willingness of older persons to use social networks and to reveal personal data?
- Is user-generated content the way forward?
- Did the related assumptions made in the project outline prove to be correct?
- What are the related barriers and opportunities for business?
- What is the true potential of social networks for improving social interaction between older adults and their families?

Session B3 – How Can End-users Inform the Development of the Business Plan of a Project?

End-users could play a crucial role in the development of business plans in the field of social interaction. As customers of new services, they will have highly valuable input to provide in the following areas:

- what is needed,
- who would use a specific solution,
- who would or could pay for it,
- what changes it might bring in the network of the end-user, etc.

This resource has not been recognized fully in the past in addressing the following questions:

- How can end-users and business partners cooperate in a productive way?
- What kind of information can or should be delivered by end-users?
- How can that information be communicated between end user and business most effectively?
- What methods have proved to be successful?

These and other questions regarding the potential of end-use involvement for shaping business plans will be in the focus of this session.

Session B4 - Methods of End-use Involvement in the Field of Social Interaction

End-user involvement is a prerequisite for all AAL projects. Related ethical issues on the micro and macro levels are of high relevance. This session will be organised as a discussion. Speakers will be asked to give a very brief introductory statement on the highlights of end-user involvement in their projects and related ethical issues (no PPP allowed). Key discussion questions are:

- Which approaches have proved to work effectively? Which were ineffective?
- Did the assumptions on older persons' needs and wishes prove to be correct? If the assumptions were not correct how did the situation differ?
- What kind of ethical issues have arisen or are expected to arise in the future project lifetime?
- What ethical issues are expected to arise after the project's completion?
- Did the consortia feel insecure with respect to ethical issues?
- Do projects need a specific framework for ethical issues?
- What kind of ethical requirements need to be fulfilled on the national levels?

Session B5 - Social Interaction of Older Persons in 2035

In this session we will explore the future needs and wishes regarding the social interaction of older persons. Questions may include:

- Will future generations of older persons have different needs and wishes as compared to the present older persons?
- How will the increasing number of single households change the patterns of social interaction?
- Digital illiteracy is diminishing: What effects might this have?
- What technologies will be available and how might future older persons use them?

For this session we are 'scanning the horizon' for visions, studies, approaches and topics that should considered in the area of social interaction of future older persons.

TRACK B NOTES

TRACK B SOCIAL INTERACTION

Gerda Geyer[1], Lóránt Vajda[2]

The focus of track B was on projects funded under the AAL Call 2 on the topic of Social Interaction, as well as on other thematically related projects at European and national levels. The aim of the track was to bring projects together, discuss relevant aspects, exchange experiences regarding success factors and problems and to learn from each other. Specific sessions addressed business aspects and ethical issues as well as issues regarding end-user involvement.

In general, attendance at the sessions was good. The number of participants ranged between 40 and 70. According to audience feedback, the narrow focus of the sessions was particularly appreciated.

Speakers were asked to address specific questions and not to give general introductions to their projects. To a large extent these session requirements were met.

All the sessions were designed to include a timeslot for interaction with the audience. The actual levels of interaction varied quite substantially from session to session. A contributing factor may have been the fact that the sessions were held in the plenary room which had been designed to seat several hundred people, while the sessions themselves were designed to be smaller, parallel-track sessions. Interaction became more lively when sessions B3-B5 transferred (some of) their activities from the podium to the audience.

1. Session B1 - Social Interaction: Focus on Gender Differences and Rural / Urban Areas

End-users' wishes and needs regarding social interaction may vary substantially. In terms of useful solutions, men and women may have very different expectations as they grow older. Whether they live in a rural or urban area may also play a role.

Key questions addressed during the session were, for example, how does the way in which people formerly lived influence their expectations in terms of social interaction? Do these differences impact the business plan?

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[1] Austrian Research Promotion Agency. Forum Committee Member, Chair of Track B, leader of the Austrian National Programme benefit, Austrian National Contact Point for the Ambient Assisted Living Joint Programme, Rapporteur for Session B1-2

[2] University of Budapest for Technology and Economics, Managing Director, Rapporteur for Sessions B3-5

Speakers were asked to focus strictly on the above questions and the related preliminary outcomes of their projects. Each speaker was given 10 minutes to provide insights into the project's experience (no overall description of the project or consortium was allowed).

Kurt Majcen, Joanneum Research (Austria), Elderly People – New Media … A Contradiction or Chance? – Experiences from the ALICE project

End-users involved in the ALICE project are older than 60, some are even older than 90. The largest age group is 70-79 years old. Many of the end-users involved have rather low incomes. More females than males are involved. 82% of the participants live in urban areas, as defined as a town, city, etc., whereas a rural area is defined as a single household in the countryside. In interviews older people judged the use of technologies as too complex, hard to understand, boring and unnecessary for the old. But the use of technology was also seen as exciting and offering surprising possibilities. There was interest in participating in the pilot, but for the consortium it was too difficult to recruit older persons. The drop-out rate was also rather high.

Paolo Ciampolini, Centro TAU (Italy), AAL Tools to Contrast Rural Area's Depopulation

The Parma region is experiencing a flight from rural areas. Most people are living in the province, not in the mountains. The ageing problem is much more severe in the mountain region. Young people continue to move to urban areas because of the lack of schools, healthcare, transportation and employment etc. As a result, the efficiency of the services falls. Breaking this vicious circle is a complex policy issue. AAL is seen as a tool focusing on home safety, remote monitoring and communication/inclusion.
AAL is included in a much wider set of actions aimed at fostering "domiciliarity". The project started in 2005, with the first trial performed in 2007.

The AAL activities are based on

- CARDEA system (UniPR, i-cubo)
- CARDEA: environmental safety
- MUSA: personal monitoring (fall detection, vital signs, …)
- CARDEAweb: remote monitoring and control

Now efforts are being made to move towards independent homes in order to allow people to stay at home in the mountains. This requires the provision of services.

Bernhard Woeckl, CURE (Austria), SHARE personas

Bernhard Woeckl reported on a set of 30 elderly personas which were created as part of the SHARE personas project. Personas represent archetypal user groups. They illustrate the target users and enable a transparent, vivid and realistic representation of the abstract user. They establish a unified representation of the target group and generate strong focus and also have the potential to create sympathy and empathy with the target group if deployed in a specific RDI project.

The elderly personas are based on real data from the SHARE database (120,000 seniors from 8 European countries).

The models were created following a four step plan:

- analysis of 73 national and international projects
- result: chronic diseases, social inclusion (independent living), smart home (telecommunication, mobile UI)
- filter SHARE database to identify requirements. The following variables were defined: health aspects, limitations, risks, cognitive functions, care, activities, social aspects, economic aspects
- cluster analyses: central Europe (Austria and Germany), Southern Europe (Italy, Spain, Greece) Northern Europe (Sweden, Denmark, the Netherlands)

Enrique de Miguel, Vmoda, 2Mares (Spain)

Enrique de Miguel reported on RuraisLAB which is a user-centred innovation community of citizens, SMEs, university research groups and local government. It is located in Galicia with the aim of developing innovation with respect to rural women's needs and visions. The end-users have a very important role in RuraisLAB.

Methods adopted in the RuraisLAB include questionnaires, focus groups, and multimedia simulations. Several use cases were defined for the domestic sphere and "nomadic (outdoor) access".

Research conclusions suggest that within the RuraisLAB area there are no gender differences in terms of access to the internet, mobile and TV devices and services. But there are big gender differences in terms of education and social roles:

- 27% of the women take care of family & the elderly – vs. 2% of men (strongest difference in rural areas)
- 0% "householder" men (vs. 15% women)
- More unemployed women (10%)
- Fewer women have university degrees (18% fewer than men)
- 28% less knowledge about internet use in women (> 60 years)

Other outcomes:

- Women LOVE and NEED social interaction with others
- Most elderly people LOVE LEARNING new things
- ICTs function as a FACILITATOR for:
- CONNECTING elderly women (and men) with their social environment
- LEARNING

Laurence Triouleyre, University of Geneva (Switzerland), Osteolink: The IOF's innovative online and in-person social network dedicated to osteoporosis

Osteoporosis affects one in three women and one in five men over the age of 50. Osteolink is an online and in-person social network dedicated to people who care about osteoporosis. The first project tests were carried out in Austria and Sweden.

These two countries are interesting because Austria is one of the countries with the lowest levels of internet use in Europe, whereas Sweden has one of Europe's highest levels of internet use. An initial conclusion that the project can draw is that membership is split along gender lines.

Discussion

The final discussion among the panelists raised the question of whether the last presentation suggested that women in Austria were more willing to use the internet than men. The reply clarified that, according to the project experience, women search the internet more often to find health information. It was also pointed out that some studies indicate that women use the internet more frequently for maintaining social interaction.

Session B2 - Social Interaction – Focus on Social Community Networks and ICT-based Services

The session was organised around the following questions: how do older people behave with regard to social networks and ICT-based services? What assumptions do, and did, projects make regarding the willingness of older people to use social networks and to reveal personal data? Does the future lie in user-generated content? What are the related barriers and opportunities for business? What potential do social networks provide for improving social interaction between older adults and their families?

Speakers were asked to focus strictly on the above questions and the related preliminary outcomes of their projects. Each speaker was given 10 minutes to provide insights into the project's experience (no overall description of the project or consortium was allowed).

A final discussion with intervention from the audience was planned to conclude the session.

Anja Leist, University of Luxembourg (Luxembourg), User Requirements in ICT-Based Social Media Use: Acceptance of a Virtual Coach - Project V2me

Project V2me aims at alleviating loneliness, enhancing quality of life and the social connectedness of older people. The means used for reaching this goal are a virtual coach which acts as a mediator and friend, functionalities to keep in contact with others, and a friendship-enrichment programme to find new friends.

First tests on user acceptance performed in the project showed that, in general, there are big differences between reported and observed ease of use. It was reported that the handling of the tablet was easy. The emotional quality of interacting with the system was reported to be positive or at least neutral. In contrast, the observed ease of use in the testing showed:

- The handling of the touchscreen was quite difficult.
- There was some reluctance to adjust system presettings, e.g., mood.
- "Repeat Icon"
- Instructions by the coach are necessary throughout the project lifetime.

End-users also expressed the wish for something fun.

Preliminary conclusions and recommendations:

1. Constant end-user involvement through user-centred design and implementation & constant feedback process
2. Constant support and training throughout system use
3. User awareness regarding users' social networks and physical environment

Stijn Bannier, Maastricht University (The Netherlands), The Rise of the Silver Surfer: Web 2.0 Participation by Seniors – Preliminary findings from the AAL Project TAO

Stijn Bannier started his presentation by stating that seniors make only partial use of the possibilities that ICT offers for social interaction. They also underestimate the opportunities that ICT can open up to them. The project examined and compared three datasets: SeniorWeb.NL, Flosspols Developer Survey and Wikipedia Survey.

Results:

- Seniors are not using the Web 2.0 possibilities to their full capacity > Web 2.0 participation
- The potential of actively participating seniors can be seen in the Wikipedia and FLOSS online communities.

Older generations add substantial volumes of contributions to Wikipedia.

Benjamin Wimmer, CURE (Austria), I Am Here For You: Sharing the willingness to communicate within social networks of older persons living at home - Project Amcosop

The idea behind the Amcosop project is that, in order to foster communication and reduce the loneliness and fear of isolation suffered by older people, it is important to know that someone is available. This availability is made possible via the so called "Elderly's Safety-Net", a group including family members and friends as well as care-providers and other tertiary users. Before establishing a safety net several questions have to be clarified, both by the primary and the secondary end-users.

Testing showed that older adults are willing to participate in social networks. The functionalities are seen as beneficial. The presence-sensing approach is welcomed. An important issue is to clarify who should be in the network and with whom one would like to share information. The closeness is important (family members are not always close).

Important aspects involved in designing the elderly safety-net are:

- Iterative requirements analysis
- Inclusion of, and exchange between, all user groups
- User-centered design approach
- Consideration of human values
- Use of mock-ups as early as possible

Gabriel Swatzell, Microlink PC (UK), Centre de Recerca I Investigació de Catalunya (CRIC), Seniorengage: Virtual Network to Empower the Integration of Seniors into an Active Community in the Post Retirement Years

Gabriel Swatzell started his presentation by providing some statistics: 45% of 55-74 year olds go online to read newspapers. Internet use by older people has nearly doubled over the past 5 years. E-mail is the most used internet service among people aged 60-79 in UK (63%).
He stated that seniors who use social networks show cognitive performance improvements, benefit from feelings of well-being, are less depressed and lonely, maintain relationships and learn new skills.

According to him, the key points with respect to the questions posed in the session are:

- Seniors, like any other internet user, mostly use the internet to communicate via email
- The future lies in TARGETED user generated content
- Inclusivity in communication is the key to senior use of social networks. We simply need to bridge the gap between seniors who email, and seniors who can use a social network for communication

Verena Fuchsberger, University of Salzburg (Austria), Intergenerational Activities – Supporting the Relationship between Grandparents and Grandchildren through Online Activities

The FamConnector project is about communication with family members and uploading photos. While face-to-face-relationships consist of communication and activities, in remote communication activities are restricted.

However, grandparents are very interested in using ICT in order to stay close to their grandchildren. The willingness to use the platform depends on the personal living circumstances. Older adults were critical about the definition of benefits.

The expectations have been articulated very clearly.

The issue of revealing data must be dealt with carefully. FamConnector does not require participants to reveal much data (just the first name of the grandchild and e-mail address). The grandparents did not ask to create their own content.

Perceived barriers in the project were that grandparents might not have confidence in their computer skills and the benefits might not be obvious to them.

Discussion

In the final discussion the subject of safety and trust was raised. How will future generations behave in this respect? Gabriel Swatsel replied that privacy is not something that only impacts seniors, it is important to everyone. Having a person's e-mail address allows one to discover their age, sex, preferences. While computer skills are an important topic for current projects, it is commonly expected that they will not be a problem in 10 years time.

Session B3 - How Can End-users Inform the Development of the Business Plan of a Project?

End-users may play a crucial role in the development of business plans in the field of social interaction as end-users' knowledge about

- what is needed,
- who would use a specific solution,
- who would or could pay for it,
- what changes it might bring about in the end-user's network etc. is very valuable input.

This resource has not been fully recognized in the past. How can end-users and business partners cooperate? What kind of information can or should be delivered by end-users? How does it work? What methods have proven to be successful?

These, and other questions regarding the potential for end-user involvement in shaping business plans, will form the focus of the session.

Speakers were asked to add their experience and knowledge of end-user involvement to the development of a business plan (e.g. as outlined in AAL Call texts).

Pekka Kahri, the Chair of Track B3, started the session by raising two main questions:

- *How should users' needs affect technical requirements?*
- *What role can end-users have in creating a business plan?*

On the other hand, Pekka Kahri mentioned that when the AAL Joint Programme was launched, the focus was placed on the user, and he tried to address how the technical responses could be used.

- *Involvement of end-users to ensure that real needs are addressed*
- *Participation of different value chain actors in the project consortia*
- *Enforcement of market orientation and business models*

The users, the development and the market. IMPORTANT:

- Business and product research and development is expensive and risky;
- Individuals do not always behave rationally but are driven by "animal instincts". They do not always know what they need or want, and rarely express this unambiguously. Neither do they always like what is being developed, but still they need to be involved in the development;
- End-users are not always individuals, they can also be groups of people.

"The role of end-users in the development of business plans"
Sabine Wildevuur, Creative Care Lab Waag Society
Thomas Hammer-Jakobsen, Copenhagen Living Lab

Sabine and Thomas represent a project started by a consortium in April 2010. The main objective of the project is to develop a game platform on which the elderly, children and grandchildren, CAN and WANT to play together. This platform was projected on the desk, five concepts were developed, end-users were questioned, three prototypes were produced, and one solution was chosen by the end-users. The business plan was developed and redeveloped in parallel.

In order to develop the business plan the consortium used the Business Plan Canvas published by Osterwalder et al. (http://en.wikipedia.org/wiki/Business_Model_Canvas) in Business Model Generation (2009). They tried to fill the published canvas with the needs as follows:

- Initial need identification
- Co-creation using different kinds of prototypes
- Structured feedback from users for every new version

During the planning 4 Ps were involved: (P1) Patient/user; (P2) Producer, (P3) Payer, (P4) Provider.

Take-away ideas after the presentation:

- Involvement of the end-user is the very basis for business modelling
- Involving the end-user will change the scope of business plans
- T-shaped organizations: Change will challenge project setup – requiring redefinition of partner roles and involvement of new partners.

Questions to the speakers:

Question1: *Did you find an effective business model which can actually work in real life? When do you think your business plan can be exposed to real life?*
The business model is for a game which allows the elderly to share pictures and enable conversations. It has low distribution costs, low provisioning costs and is easy to use by the players (elderly, children, parents). The consortium is just about to reach the target of exposing the application developed with this business model to real life.

"A social reminiscing system for intergenerational communication: user needs analysis"
Luca Morganti, Istituto Auxologico Italiano, Italy

The speaker emphasized the Italian context of making business plans, pointing out in particular the important role of end-user involvement and the methodology for communicating with elderly people.

The main task of the NoBits (Nostalgia Bits) project is to foster social interaction between elderly persons and their families by capturing and sharing their memories online.

They developed a website where elderly people can share memories by collecting their memories, which are then uploaded to the web by their children and grandchildren who know how to use the internet.

Two different objectives were chosen in order to reach the goal: a psychosocial objective and a technological objective.

Results at a glance:

- Negative memories have a positive value for several reasons.
- Reminiscing is considered a spontaneous activity that should not be planned or scheduled.
- Technology does not scare the elderly too much and they are not as afraid of losing privacy or being cheated on the internet as we may think.
- The elderly totally disagreed with ratings and comments.
- Children would really like to connect their NoBits activities with their social network accounts and share them with friends.
- The elderly didn't like the idea of a mobile version of the NoBits website.

As a side result of this project, it turned out that a good methodology for involving the elderly is to use questionnaires in parallel with PowerPoint presentations which help them understand the questionnaire better. In this way the users do not lose interest in the overall project.

Questions to the speaker:

Question1: *I am 70 years old. 10 grandchildren. I didn't understand what your project is, what it is you want to sell.*
This presentation is not about selling a product. It is about the methodology of how to create such a website. Through this social network we want to give children something; the elderly put in the knowledge, children provide the ability of working with the Internet.

Question2: *How will you use this solution?*
We are currently creating this platform and are also working with senior centres and schools. We are making plans for how this platform can also be used by municipalities, for example, to strengthen communities.

"End-user business modelling cooperation"
Victor H Hernandez Ingelmo, FASS Junta de Andalucia, Spain

The speaker works with a telecare services provider for governmental organizations in Andalusia. They contact end-users directly by phone and ask them about the solutions which have been, or are being, developed in different projects. They use an end-user contacting methodology comprising several levels.

A methodology, called „3I", has been defined:

- Integration: call users and ask them about the ideas;
- Intuitiveness: make a draft model of the idea and have focus groups discuss them;
- Information: inform the users about the developed product;

This project uses the telecarers as Community Managers in online social networking for the elderly. These Community Managers are responsible for uploading content and reviewing the material that users have uploaded.

The main proposal of this group is to involve a Middle Man if social networking is to work. In this way the success of the project and the success of the business model is guaranteed.

On the other hand, end-users MUST BE involved in business planning, because in the end they are the potential customers.

Question to the speakers from the Chair:

Question1: *The amount of input is enormous. What is a good balance for filtering the information?*
Speaker1: We organize focus groups.
Speaker2: We don't rely solely on end-user input. It is interesting to figure out what the end-users' needs are. We are not asking what they want. We try to figure out what they want and then allow them to choose from several possibilities. The users should not be the designers, they should be the reviewers.
Speaker3: We try to give guidelines and ask them if our solution is good for them.

Take-away ideas from the Chair of Track B3:

Take users, ask them, observe them, change the project course when needed. These days a project is based on a 3-year project plan, which does not encourage agility and responsiveness to changing needs. This cannot be changed right now in a European funded research project, but maybe new methods for running close-to-market projects should be considered.

Don't forget: A good business model aligns with customer's drivers or/and relieves the customer's pain!

Session B4 - Methods of End-User Involvement in the Field of Social Interaction and Related Ethical Issues

End-user involvement is a prerequisite for all AAL projects. Related ethical issues on the micro and macro levels are highly relevant. The session was organised in the form of a discussion. Speakers were asked to give a very brief introductory statement highlighting end-user involvement in their projects and related ethical issues (no PPP allowed). The discussion focused on the following questions: What has been proven to work well? What did not work? Did the assumptions about older persons' needs and wishes prove correct or not? What kind of ethical issues arose and are expected to arise in the future project lifetime? What ethical issues are expected to arise after project completion? Did the consortium feel insecure with respect to ethical issues? Do projects need a specific framework for ethical issues? What kind of ethical requirements needed to be fulfilled at national levels?

Participants

Heidrun Mollenkopf, Age Platform
Maria Schwarz-Woelzl, ZSI (Austria), Project Go-myLife
Jonathan Matthew Bennett, University of Applied Sciences Bern (Switzerland), Project TAO
Stefanie Wengel, Diakonie Moosbach (Germany)
Tuula Petäkoski-Hult, VTT (Finland), Project SoMedAll
Silvio Bonfiglio, FIMI BARCO (Italy), Project NoBits

Frank Walhoff, Technical University of Munich (Germany), Project ALIAS
Stefan Schürz, Lifetool (Austria), Project HOMEdotOLD

Notes:

Gerda Geyer gave a brief introduction on how Session B4 should deal with ethical issues, social interaction, different barriers, and future perspectives.

The speakers started by explaining their ideas and background on end-user involvement. Statements included:

- It is effective to have intense user involvement in any research project. It is important to understand user needs. It is also necessary to strike a balance between business goals and user needs.
- Cultural differences must be considered when end-users are involved. Ethical issues are important and must be addressed during the pilot phase.
- It should not be forgotten that the users are elderly people. They all have their own profile. It is not easy to apply methods to a specific population. It is hard to make profiles for these people.
- Everybody agrees that users must be included. The question is, what does the consortium understand by inclusion? What kind of users should be involved? This should be the starting point for every project.
- Technology should not take precedence over people. What people want from technology must be considered. It is often more efficient where caregivers are involved in the development rather than the elderly directly. The caregivers usually know what the elderly need.
- End-users are not the winners of the game. They are not sure that they will use the systems they are testing, after all. They need to understand that it is not about their benefit.
- End-users should be involved before the kick-off meetings, or even before writing the project proposals.

When asked about what the process of recruiting older end-users should be, the speakers proposed a variety of processes. The answers showed that some of the speakers recruited through centres for the elderly, for some the method varied depending on the age group which needed to be involved, others simply went to shopping malls and asked people they found there.

There must be trust when (older) end-users are approached - e.g. older adults may have regular club sessions where this trust has already been established. Where the group leaders are involved, this feeling of trust is easier to achieve. Successful end-user involvement relies on personal contacts. Impersonalized treatment does not create situations of trust and thus does not support end-user involvement.

A simple method of establishing end-user involvement is as follows: guideline-based interviews => mock-up software development => elderly feedback => first prototype => pilot-site development => testing at different test sites.

If guideline-based interviews with focus groups are considered, the topics need to be changed periodically in order to maintain end-user interest (e.g. games: the games need to be changed from time to time).

All the speakers agreed that it was always very important to give a personal introduction to every system in simple language, in order to overcome barriers that could hinder use.

An important issue is technology and knowledge transfer between the social and technical research groups. Even people working in these two fields cannot easily understand each other.

Wrap-up and take-away ideas from Track B4:

End-user involvement and personal relations are needed in AAL projects.

- It is important to define the group of end-users for inclusion in the projects carefully. It would be beneficial to involve them at the project proposal stage.
- It is important to build up a relationship with the end-users involved in the project.
- Communication is needed between the social science and technical groups – this is not always easy: could be investigated to help communication.
- Overview on methods of end-user involvement would be helpful.
- Project exit strategies have to be reconsidered.
- A framework for ethical issues is needed by the participants in the AAL field.

Session B5 - Social Interaction of Older Persons in 2035

This session explored the future needs and wishes of older people with regard to social interaction. Questions included: Will future generations of older people have different needs and wishes compared to today’s older generations? Will the increasing number of single households, for example, change patterns of social interaction? Digital illiteracy is diminishing: what effect will this have? What technologies will be available and how will we use them?

The session aimed at ‘scanning the horizon’ for visions, studies, approaches and topics that need to be taken into account in the field of social interaction of older people.

Each speaker was given a few minutes to present their ideas.
A final discussion with interventions from the audience concluded the session.

Notes:

This session explored the future needs and wishes of older people with regard to social interaction. After his welcoming words the Chair, Urs Guggenbühl, outlined present and future trends. An important point is that the number of elderly persons is growing, and funding is becoming a problem. New ways of funding need to be explored. Another trend he mentioned is that technology develops exponentially. The question is this: will future generations speak about individuals as bionic persons? The geographical location of care delivery will also change. There are trends towards investing in care cities outside Europe, where this activity is also achievable at lower prices (e.g. Asia, China).

"Caring for very old people in 2035: the need for continuity of social interaction", Matti Groot, Verklizan, The Netherlands

The speaker explained that his company has been working with a large number of elderly people, delivering telecare services. Based on his professional experience, he judged that in the next 25 years the major problem will be older people's social isolation and feelings of loneliness.

The speaker mentioned three main, important topics:

- **Social duty of care, innovation and new (business) opportunities**
  - There is a need to shift the responsibilities for elderly care;
  - It is time to answer a key question: Are we saving money or saving people?
  - Everybody needs to belong somewhere;
  - In the future we need new responsibilities, new services and new budgets;
- **Empathy and technology**
  - These days most caregivers are against introducing new technologies in homes. This is mainly because they have not been properly informed about what these systems can do;
  - New types of avatars in social networking need to be introduced: seeing smiling faces makes us smile;
- **Informal care communities empowered by AAL services**
  - Volunteer work needs to be mobilized, with, for example, older people caring for the very old, and linking volunteer activity to a professional knowledge base;
  - Large-scale services, embedded in a professional environment;
  - Mobilizing informal care in a responsible, inclusive and robust manner.

Take-away ideas from the speaker:

- We need to consider the early indicators as well as prevention.
- Carers need more support, explanations about what technology is able to do for their patients and for them.

Questions to the speaker:

Question1: *Empathy in the future, technology, how would you regulate this? Standards? Political standards? Technological standards?*
We already have some regulations in different countries. We have to be careful when we extend these regulations.

Question2: *When and who wants to keep contact with avatars? Is it really a solution to use avatars to replace people?*
Based on our findings elderly people are quite open to using avatars. Older people even appreciate the use of avatars.

"Social Interaction of older people in 2035"
Sharon Prins, TNO, The Netherlands

The speaker started the presentation with some simple arithmetic: in 2035, today's 38-year old user will be 61 years old. So, a fair question is this, "knowing the state of today's technology, what do you think you will need then?"

She explained the code designing methods used today and arrived at a very important conclusion: if you have more social interactions, you are happier!

A future user of AAL systems needs support in three basic areas:
- need to communicate;
- sharing and getting information, with special attention to privacy issues;
- opening connections with a community;

The speaker's conclusions dealt with the devices for use in the future:
- Devices should be tablets, which are easy to learn and easy to use;
- Touch screen dialling is ideal for future phones.

"Feeling, following and reflecting on the Community Rhythm"
Chiara Leonardi, Mario Conci, Fabio Pianesi, Massimo Zancanaro, FBK, Italy

The speaker offered a fresh view of social network use, which is strongly connected to the physical world. This raises ethical, security and personal questions which need to be answered.

Loneliness and social interaction are hot topics in the life of elderly people, both today and tomorrow. As we have already seen, people need to be directly connected, they need the sense of community and the power of community.

The speaker underlined the importance of connecting behaviour recognition (i.e. recognition of Activities of Daily Living – ADLs) directly to today's social networks. A virtual presence is also becoming realistic thanks to social networks.

A new term has been specified, the “Community Rhythm”:

- Communities can encourage the individual to participate in self-improvement activities;
- Communities can foster engagement through social networks.

The speaker mentioned two scenarios as examples for such social networks - social cooking and good-morning coffee.

Questions to the speaker:

Question1: *Bringing social networks closer to the physical world is a nice but strange idea. I am not sure older people would want that. The question is if social networks should be encouraged in a more physical form, for example by picking people and putting them together in a room.*
I don’t think the kind of solution mentioned above is a substitute for personal contacts. Let’s provide older people with some kind of infrastructure and try to explain them how it should be used.

“Social Interaction of Older People in 2035” Leonardo Martinez Suarez, Cetiex, Spain

The speaker’s primary statement was that the future generation will be different from the present one, and traditional lifestyles will be, and will have to be, more ICT-based. In the future elderly people have to be involved as active agents with an active role in society. This can be enabled using communication technologies.

Take-away ideas from the Chairman

Avatars, co-designed worlds, rethinking social networking, connecting the elderly and giving them active roles in society – all with the help of ICT. For the Chairman it had been a hopeful sign that no one had foreseen biological implants, or bionic elderly in 2035. Hopefully in 2035 we will use services as humans and not as robots. In 2035 we will still need social networking. In 2035 we will still need personal contacts.

TRACK B PAPERS

ELDERLY PEOPLE – NEW MEDIA … CONTRADICTION OR CHANCE? EXPERIENCES FROM THE ALICE PROJECT

Kurt Majcen[1], Alexander Stocker[1], Harald Mayer[1], Mike Dorst[2], Paul Dijkgraaf[3], Karl Blümlinger[4], Francisco J. Nuñez[5]

Abstract

The ALICE project (www.aal-europe.eu) coordinated by Joanneum Research aims at connecting elderly people with their families and friends. This will be done by typical social interaction services using Web 2.0 but also with an additional video conferencing service. The technology to be used for that purpose is not a personal computer but a set-top box connected to a television set. This equipment can be found in the home environment of most elderly people. A survey was conducted and pilot experiments performed to learn more about the elderly people, their specific requirements of such applications and potential limitations when using the envisaged devices and their user interfaces. Potential clients of such experiments were asked at the beginning of the project about their communication habits and media usage. The results of that survey are described in this paper.

1. Introduction

The world wide web and especially developments around the Web 2.0 over the last years [1] have enabled people to interact with like-minded people and share content in various forms (music, videos, photographs, presentations etc.) and in a self-organizing manner. This user-generated content is shared via platforms like YouTube, Facebook, Google+ and others in private but also in business contexts. Young people make use of mostly free platforms to have fun and to follow the activities of members in their private social networks.

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But what about elderly people? From research [2, 3] it is known that the internet can help elderly people by easing the loneliness they may feel due to losing friends and family members. This leads to the idea of bringing the elderly people to the aforementioned platforms. Although it is obvious that the use of these modern services would, in some way or another, bring people together, this may not be the case in practice with the elderly. Many elderly people lack the necessary knowledge about computers, the internet and social networking tools. They usually lack competence in using these media. Furthermore, the complexity of platforms and the very fast evolution of the technologies make elderly people feel uncomfortable, stressed or even frightened.

One way to get around this is by moving such services to other, more familiar, platforms. One example is the common television (TV) set which can usually be found in the home environment of elderly people. Further combining these services with others (e.g. video conferencing and medical devices) will create some value for the elderly people and improve acceptance. Elderly people normally do not use new equipment and services just for fun, as the younger ones (especially children) do, but clearly ask themselves what is the added value of new systems or tools. Usability is a third important aspect when introducing new services even in familiar platforms as elderly people usually suffer from limiting constraints (poor eyesight, using a different wording, difficulties with manually operating devices etc.).

The project ALICE (Advanced Lifestyle Improvement System and new Communication Experience) coordinated by Joanneum Research develops a set of Web 2.0-based interactive services which are available on a set-top box and can be used with a normal TV set. Thus elderly people are enabled to have communication and social interaction with their loved ones in the environment they are used to.

Knowing about the clients of a future system with different kinds of services developed in the ALICE project is important. A solution which is widely accepted and which is marketable after the project can be only achieved by ascertaining what clients like or do not like within those services and what the reasons are for that. Therefore the consortium interacted with potential future clients – in this case with the clients of Mens en Zorg (a Dutch care organization in the consortium which will also conduct the planned pilot experiment) – right from the beginning of the project. The care organization offers assistance at home for (mostly elderly) people who want to live in their homes more or less independently for as long as possible.

2. Methods

The first step for analysing the clients' needs was a general survey among all the clients of the care organization to determine their demography, their social networks and interactions. Next, the survey questioned their communication habits and usage of traditional and modern media. Furthermore a subjective impression of their mental and physical fitness was requested along with their opinion on the modern and rapidly changing world. Finally, they were asked about their willingness to participate in a pilot trial of the ALICE project.

Following the survey those clients who indicated their willingness to participate in the pilot were interviewed. One further step was taken at a very early stage in the project: a pre-pilot experiment with the selected clients. In this experiment the initial system configuration, as available at that time, was installed in the homes of the elderly and with the video conferencing service enabled. The main interest was to ascertain the acceptance of the envisaged solution in principle, and to get early feedback on behaviours and aspects of the system which are well perceived or which may hinder a successful pilot in the project later on.

The project team wanted to learn from the survey and the interviews for guidance on the services to be developed as planned in the work plan.

3. Results

The survey was done with all the clients of the care organization Mens en Zorg. It proved impossible to achieve all the answers directly in one pass. The staff of the care organization had to assist with the completion of the questionnaires in many cases. In the following we present several results on the main topics from the survey.

3.1 Demography

The overall return was 109 questionnaires: 63 from women and 46 from men (an unsurprising distribution in the group of elderly people). The following tables present data about the age of respondents, their monthly household net income and highest level of education.

Table 1. Demographic data (age groups, household income, and education)

Age group	Total	Women	Men	Monthly household net income (€)	Total	Women	Men
<=60	3%	5%	0%	500-1000	26%	37%	13%
61-70	26%	30%	20%	1000-1500	37%	30%	47%
71-80	36%	31%	43%	1500-2000	16%	16%	16%
81-90	30%	28%	32%	2000-2500	12%	11%	13%
>90	6%	7%	5%	>2000	9%	7%	11%

Highest level of education	Total	Women	Men
primary	33%	39%	24%
secondary	50%	48%	53%
university	11%	7%	18%
other	6%	7%	4%

Half of the respondents answered that they have reached the secondary education level, with men overall having a higher level of education than women. For income, about two thirds of the people received less than 2000 € per month, but this also shows a gender difference, with men having a higher monthly income than women.

The distribution of residences (urban or rural) was also checked using data from the care organization. Urban area was defined as village, city etc., while rural area includes single households in the countryside. The percentage of urban households was 82%.

3.2 Family and Friends

In the following the family status and the number of (grand) children and good friends is shown. About half of the respondents live alone or are widowed. A large number have two or more children or grandchildren and a similar number of good friends.

Table 2. Family and friends

Family status	Total	Number of children	Total	Number of grandchildren	Total	Number of good friends	Total
Married	39%	0	15%	0	19%	0	6%
living alone	17%	1	12%	1	2%	1	14%
widowed	43%	2 to 3	52%	2 to 3	28%	2 to 3	29%
		more than 3	21%	4 to 6	26%	4 to 6	21%
				more than 6	25%	more than 6	30%

The distance to those other people in their social networks is also of interest. More than half of the relatives do not live in the same neighbourhood. The situation differs for good friends who live more nearby (i.e. same neighbourhood or village).

Table 3. Residence of people in the social networks of elderly

Residence	Children	Grandchildren	Relatives	Good friends
in the same household	1%	1%	0%	0%
in the same building	2%	0%	2%	1%
in the neighbourhood	16%	13%	7%	19%
in the same city/village	16%	12%	25%	43%
within a radius of 50km	41%	39%	45%	28%
more than 50km away	23%	34%	22%	9%

3.3 Social interaction

The survey sought to elicit the respondents' desire for social interaction with their social network. As can be seen in Table 4, more than half wish to have personal contacts at least once a week. The respondents desired more frequent contact with children than with friends and other family members.

Table 4. Desired frequency of contacts

Contacts desired	Children	Grandchildren	Relatives	Good friends
Every day	17%	6%	8%	5%
A couple of days a week	28%	17%	16%	16%
Once a week	37%	35%	32%	41%
Once a month	16%	35%	37%	30%
Once a year	3%	5%	5%	5%
Never	0%	2%	2%	3%

The survey also asked about the current situation (Tables 5 and 6). The majority of social contacts were reported as happening once a week or once a month. Children are contacted more often, which corresponds to the desire for more frequent communication. Contact via writing letters is unexpectedly low.

Table 5. Frequency of face-to-face contacts and writing letters

Face-to-face contacts	Children	Grandchildren	Relatives	Good friends	Writing letters	Children	Grandchildren	Relatives	Good friends
Every day	13%	4%	5%	8%	Every day	0%	0%	0%	0%
A couple of days a we	18%	8%	5%	8%	A couple of days a we	0%	0%	1%	1%
Once a week	32%	25%	23%	33%	Once a week	1%	0%	0%	1%
Once a month	30%	48%	48%	34%	Once a month	7%	5%	2%	4%
Once a year	7%	13%	18%	10%	Once a year	11%	13%	22%	20%
Never	0%	2%	1%	7%	Never	82%	83%	75%	74%

The questions regarding the frequency of phone calls again showed that participants call their children more than the other groups (in most cases at least once a week). Grandchildren and other relatives are less frequently called than good friends. Table 6 shows that email and internet-based communication are not used very much.

Table 6. Frequency of telephone calls and contacts via email or internet-based services

Phone calls with children	Children	Grandchildren	Relatives	Good friends	Email / Internet	Children	Grandchildren	Relatives	Good friends
Every day	18%	0%	5%	2%	Every day	0%	0%	0%	0%
A couple of days a we	24%	16%	15%	20%	A couple of days in a v	3%	2%	4%	4%
Once a week	45%	18%	27%	21%	Once a week	5%	2%	3%	3%
Once a month	4%	32%	38%	35%	Once a month	12%	9%	11%	9%
Once a year	3%	15%	5%	11%	Once a year	3%	2%	1%	3%
Never	5%	19%	10%	12%	Never	78%	85%	81%	81%

3.4 Usage of media

The survey asked about three important media in today's daily life and their current usage: television, telephone and internet/email. Television has a broad acceptance (rather independent of the gender of the respondent). A similar rate appears for telephone. The internet/email is not very intensively used, but is more frequent among the male respondents whereas the phone is used more by the female respondents.

Table 7. Usage of TV, phone and email/internet services

Enjoy watching TV	Total	Women	Men	Daily TV consumption	Total	Women	Men
yes	78%	77%	78%	less than 1 hour	14%	9%	18%
rather yes	19%	18%	20%	1 to 3 hours	42%	47%	39%
rather no	3%	3%	2%	3 to 5 hours	28%	27%	30%
no	1%	2%	0%	more than 5 hours	15%	18%	13%

Enjoy using	Phone total	Phone women	Phone men	Email/Internet total	Email/Internet women	Email/Internet men
yes	78%	87%	64%	19%	13%	28%
rather yes	17%	8%	29%	9%	10%	9%
rather no	3%	2%	4%	4%	0%	9%
no	3%	3%	2%	68%	77%	54%

The answers about daily consumption of TV programmes show that more than 40% of participants watch TV at least 3 hours a day, 15% even more than 5 hours.

Some more questions were asked about the use of modern devices like mobile phones and about other aspects of media consumption (e.g. which content is consumed).
In the interviews with a smaller group, respondents were also asked to give the reasons why they accepted new services or technologies are did not. The reasons for not using mobile phones were "not necessary", "too complicated", "too modern" or just "I'm too old for that". Regarding the internet similar answers were given (e.g. "have not learned that", "too old", "no interest" and "do not own a computer").

4. Discussion

Although there were differences in the answers to some questions between male and female participants, gender had no direct influence on the proposed ALICE services and their exploitation. The same appeared for the distinction between urban and rural residents.

From the interviews and the pre-pilot experiment, practical lessons could be learned:

- The elderly have families and friends and want to stay in touch with them. In many cases the distance is too far to have direct contact.
- People would be willing to pay a monthly fee of 10 to 15 € for the use of the proposed services.

- There are rather trivial problems that may hinder successful introduction of new technologies for elderly people (e.g. cables lying around, sound quality of conferencing video and echo effects, devices switching on or off unexpectedly or remote controls interacting with the wrong devices).
- New technologies are not per se unacceptable but the interest in such technologies varies between men and women.
- People want to stay in touch with friends and families but they are neither writing emails nor letters for that purpose.
- The children and grandchildren know about modern technologies and are able to help their elderly relatives to make use of those technologies.

5. Conclusions

In this paper we present some results from a preliminary survey and interviews for the project ALICE. The survey dealing with communication practices and media usage of people aged 60+ was conducted by the Dutch care organization Mens en Zorg. These results will be used to develop Web 2.0 based services which fit the needs of the elderly people. The first services – photo sharing, greeting cards and video-conferencing – are currently tested in a pilot at Mens en Zorg. Technical support and commercial exploitation of the platform and services developed by Zydacron and Joanneum Research will be done by ThuisConnect later on. A software manager for medical devices developed by AT4 wireless will allow standardized integration (according to results from IEEE 11073 and Continua Health Alliance) in the future. Elderly people will get the chance for a longer self-determined life in the environment they are familiar with.

Acknowledgements

The ALICE project is partially funded within the transnational Ambient Assisted Living Joint Programme (www.aal-europe.eu) of the European Union. On the national level it is funded by Bundesministerium für Verkehr, Innovation und Technologie and the benefit Programm (both Austria), ZonMw (Netherlands) and Ministerio de Industria, Turismo y Comercio (Spain).

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ELDERLY PERSONAS
A DESIGN TOOL FOR AAL PROJECTS FOCUSING ON GENDER, AGE AND REGIONAL DIFFERENCES

Bernhard Wöckl[1], Ulcay Yildizoglu[1], Isabella Buber-Ennser[2], Belinda Aparicio Diaz[2], Manfred Tscheligi[1,3]

Understanding the needs of older users with different needs, of different gender and age, and from different regions of the EU, plays a crucial role in the success of AAL (Ambient Assisted Living) and related projects. Although in AAL projects the primary end users are defined, specific user needs often remain unclear. However, the method of using Personas [1] provides a powerful tool to make abstract quantitative and qualitative user data come alive. Personas represent archetypical users in a narrative form which are designed to broaden empathy and sympathy with the target users among designers, practitioners and researchers. The main drawback of current Personas is the lack of validity, as they are often based on qualitative data only or on quantitative data from small samples.

We at the Centre for Usability Research and Engineering (CURE) propose the CURE Elderly Personas (CeP) [2]. This is a valid set of thirty Personas based on quantitative data from 12,496 persons aged 60 and older from the SHARE (Survey of Health, Ageing and Retirement in Europe) dataset [3]. They focus on gender, EU region (northern, southern, central) and age (60–69, 70–79, 80+). CeP represent an accurate picture of the older European population including socio-demographic parameters, social life activities and interactions, communication behaviours and expectations, living conditions, ADL (Activities of Daily Living), economic situation, health status, lifestyle aspects, social networks and personal attitudes. The CeP provide an extendable and re-usable empathy tool that is designed to support AAL and related projects by enhancing the understanding of the user needs of older persons. Single or multiple CeP may be applied throughout the whole process of service or product development, supporting a user-centric technology creation. The CeP tool eases the planning of future projects as well as the development and evaluation of technology solutions and business plans. Further, deploying CeP enables more fluid

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communication about the target users as a unified picture of the users is visualized in the mind of the project team.

1. Introduction

Recent reports from the EC anticipate that in 2060 30% of the population will be older than 65 years [4]. On this account, future research will have to investigate new application fields, ways and forms of modern AAL technologies. Nevertheless, to achieve a high quality of user experience and technology acceptance among older persons it is essential to understand their needs and requirements and incorporate this information in future AAL technologies.

However, a User-Centred Design (UCD) [5] approach alone cannot cover the whole spectrum of specific user requirements since the users are often absent during diverse development cycles. In addition, many researchers and developers working on projects addressing older users lack experience in working with this heterogeneous segment of our society.

Thus, Personas [1] provide an effective empathy tool to support inexperienced researchers or practitioners as well as project activities when contact with direct users is not possible. However, the aim of Personas is not to replace the active involvement of users, but to structure complex user data and to transform it into an easy to understand form to create a unified picture of the users in the mind of design teams. Hence, the creation of Personas is time consuming, costly and requires specific methodological skills.

For this reason we created the CeP by applying a quantitative approach, generating basic Personas that are extendable and re-useable for diverse AAL project foci. The applied approach is based on the Persona layering framework [8] that creates recyclable Personas and therefore supports researchers and developers in saving time and costs.
The following sections describe the methodological approach and creation process of the CeP and present the results as well as conclusions and future work.

2. Methods

As older adults are defined as primary target users of AAL technologies, CeP were developed as representatives of the European Union population aged 60 and older still living at home with or without assistance.

The SHARE dataset [3] was selected as the basic data source since it provides a huge amount of quantitative information relevant for projects aimed at older users. SHARE is a longitudinal survey and a multidisciplinary endeavour focusing on health, social, medical aspects and limitations in ADL. In addition, detailed information on socio-demographic aspects, cognitive and mental health, life-style, behavioural risks and psychological characteristics of survey participants from different European countries are documented.

To form the basic requirements for projects targeting older users, 73 AAL Joint Programme and related Sixth (FP6) and Seventh (FP7) EU Framework Programme projects were analysed. The results were categorized into the following three main aspects:

- **Target User Group** (e.g. Limitations, chronic diseases, cognitive impairments, etc.).
- **Goals of the ICT Solution** (e.g. Therapy or drug management, e-inclusion, social inclusion, security, etc.)
- **Applied Technical Approaches** (e.g. mobile interfaces, web platforms, NFC, RFID, sensor technology, etc.)

This analysis was done to identify the whole spectrum of information that is required by researchers and developers working on AAL technologies.

In the next step, a first explorative data mapping with SHARE was performed to gain insight into variables to emphasize. Since AAL projects show a strong focus on health aspects it was decided to focus on variable groups indicating physical health, limitations in ADL, cognitive health, health care, social life and activities as well as family and household.

Based on the results of previous demographic studies [9][10] that revealed gender and age specific differences of people aged 60 and older (e.g. in health status, economic situation) as well as differences between European countries, a first descriptive analysis of SHARE was carried out segmenting the data according to age (60–69, 70–79, 80+) and gender (male, female). The outcome showed that regional differences were clearer in the 80+ age group. Based on this result the focus of the CeP was set on segmenting data for three European regions: northern (Sweden, Denmark, the Netherlands), southern (Italy, Spain, Greece) and central Europe (Germany, Austria).
Partitional cluster analysis was applied as the statistical method to form the basic skeletons of the CePs. Cluster analysis groups attributes so that similar objects having these attributes are grouped together. After several iterations, trying different variables and comparing results, the final analysis included the following seven main "cluster variables":

- **Physical Health**: Self-perceived general health
- **Limitations**: Self-reported limitations in ADL (dressing, walking, eating, etc.)
- **Cognitive Health**: Number of words recalled out of a list of ten words
- Health Care: Use of home care services in the last twelve months
- **Economic Situation**: Ability to meet needs at the end of a month
- **Social Activities**: Social activities during the last month (e.g. voluntary work, caring for a sick adult, providing help to family, friends or neighbours, etc.)
- **Family & Household**: Contact with other family members (e.g. children, grandchildren, etc.)

The resulting “numerical definitions” of the generated clusters were translated into narrative descriptions (e.g. hearing good) resulting in trait-lists for each cluster group – the Persona skeletons. After translation the skeletons were compared with each other and similar skeletons were collapsed together into one [11]. As a result thirty Persona skeletons were formed: twelve (six female and six male) for central Europe for the age group 60-79 and six each (three female and three male) representing different European regions (northern, central, southern) for the age group 80+.

Even though the SHARE data used is representative for the European population aged 60 and older, a validation workshop was organized with six researchers working on projects targeting older users and experienced in developing and applying Personas. In this workshop the CeP were evaluated and validated focusing on the understanding of the narrative text parts, the layout and graphical visualization concept as well as the reality of the included photos.

3. Results

Thirty basic CeP were generated based on data from the SHARE project [3] representing people aged 60 and older from three European regions as a reference spectrum of the older population living at home with or without assistance (see Figure 1). “Basic” refers to included information that is essential for all AAL and related projects and developments targeting older users. The basic form of the CeP can be adapted to diverse project foci including additional specific information for the concrete application area.

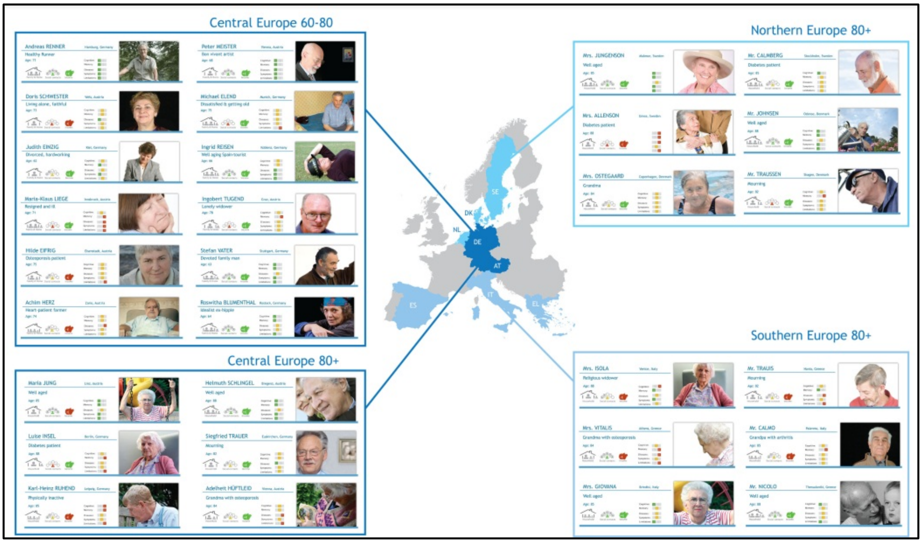

Figure 1. Overview of 30 CURE Elderly Personas

Each CeP has the following structure:

- **Name**: Indicating the main attribute of the Persona (e.g. "Mr Runner" is a healthy person who does sports regularly and wants to stay healthy).
- **Photo**: Representing the age and sex of the Persona.
- **Visualization Concept**: Providing a short summary on basic level information such as family status, household size, social activity and contacts, economic situation and basic health status.
- **Detailed Persona Description**: Narrative description of the Persona including information about family, health and social aspects as well as technology use.
- **Overview List**: Supports the detailed Persona descriptions by including information about limitations, diseases, symptoms, attitude towards technology and usage of technical devices.

The CeP are available for free at http://elderlypersonas.cure.at, which supports users with additional materials such as an online tool for filtering and grouping CeP, a detailed user manual and various templates for the creation of CeP artefacts.

4. Discussion and Conclusion

The generated set of CeP represents a valid, extendable and re-useable design tool based on data from more than 12,000 older persons living in Europe. Thus, the challenges and drawbacks of the existing qualitative and quantitative development processes for Personas – validity, cost efficiency, requirement of high statistical skills – are eliminated.

CePs may be applied within AAL and related projects to adapt solutions to the needs of Europe's ageing population better. They support initial decisions concerning the specific target user group, and scenario development or the development of business plans, since they represent the older users in a valid and understandable form. Their application incorporates data on user requirements during the whole development process and hence in the project results. In addition, their modular structure enables re-usage and project-specific adaptations to be realized with less effort and therefore encourages the application of the Persona method in future AAL and related projects. Moreover, the CeP offer a basis for thinking with and for the user throughout the whole design process, keeping the needs of older users vivid even when they are absent from research offices or development laboratories.

In further studies, our interest is to investigate the effects of CeP on project results that target technologies for the improvement of the quality of life of older adults.

Acknowledgements

This document uses data from SHARE. The SHARE data collection has been primarily funded by the European Commission through the Fifth Framework

Programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life). Additional funding came from the US National Institute on Ageing (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG 12815, Y1-AG-4553-01 and OGHA 04-064). Data collection for wave 1 was nationally funded in Austria (through the Austrian Science Foundation, FWF), Belgium (through the Belgian Science Policy Office), France (through CNAM, CNAV, COR, Drees, Dares, Caisse des Deports et Consignations et le Commissariat General du Plan) and Switzerland (through BBW/OFES/UFES). The SHARE data collection in Israel was funded by the US National Institute on Ageing (R21 AG 025169), by the German-Israeli Foundation for Scientific Research and Development (GIF), and by the National Insurance Institute of Israel. Further support by the European Commission through the Sixth Framework Programme (projects SHARE-I3, RII-CT-2006-062193, and COMPARE, CIT5-CT-2005-028857) is gratefully acknowledged.
CURE Elderly Personas materials and documents do not represent private data from any single person who participated in the SHARE project. The CURE Elderly Personas are fictitious persons synthetically generated from average traits mixed across countries. Photographs are taken from an external database. Information included in CURE Elderly Personas materials and documents does not infringe any privacy and data security rights of persons who participated in the SHARE project.

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USER REQUIREMENTS IN ICT-BASED SOCIAL MEDIA USE: ACCEPTANCE OF A VIRTUAL COACH

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Abstract

The AAL JP project V2me ("Virtual Coach reaches out to me") aims at increasing the quality of the social network in old age, thereby providing an opportunity to increase well-being and alleviate loneliness. In this contribution, the results of two empirical studies are presented that (1) aim to gain knowledge about user requirements and (2) offer first results on the usability and user acceptance of the prototype version of the V2me system.

1. Introduction

Social networks have a large impact on individual quality of life. Previous research has shown that it is not the number but the emotional quality of social relationships that is crucial to well-being in old age. With an increasing number of older people living alone, having impaired mobility, and living geographically distant from kin, it might be difficult to increase the quality of one's social network or even maintain existing social relationships. The use of ICT can overcome these shortcomings by providing possibilities for older adults to get in contact with others in the virtual or the real world. The AAL project V2me ("Virtual coach reaches out to me") has as its goal to maintain and increase the quality of the social network in old age. The project aims to develop a system that provides the possibility for elderly people to maintain existing social relationships and to find new significant social relations by using ICT-based social media. The function of the coach is twofold: (1) The coach mediates social contact with other users by providing easy-to-use social functionalities. (2) The coach helps to establish new social contacts by providing friendship enrichment lessons that are derived from a Dutch group intervention programme [1]. In this contribution, the findings of two empirical studies are presented that assessed user requirements from

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the perspectives of both end-user and professional as well as end-user acceptance of the prototype version of V2me.

2. Methods

A study on user requirements conducted in Germany in 2010 comprised workshops with professionals (nursing home staff; N = 5) and interviews with healthy elderly end-users (N = 30, mean age 80.5 years). The user acceptance study in the Netherlands in 2011 comprised workshops (N1 = 7) and interviews (N2 = 6) with older end-users (mean age ca. 79 years) who were healthy and living alone testing the prototype version of the system on a 7-inch tablet computer. Findings were acquired through both qualitative and quantitative analyses of the interviews as well as observational data from the acceptance workshops.

3. Results

Concerning the findings on user requirements, both end-users and professionals stressed similar system requirements for the ICT use of older people: (1) data security and (2) adaptability of the system to user characteristics were most important for the use of ICT-based social media in old age. Further, (3) the user interface should be easy to use and provide a low-complexity menu structure. Other factors comprised motivational aspects of the ICT system: (4) The older users stressed the informational aspect of an ICT system to keep the user connected to daily life via news or interest groups. (5) The system should involve a positive user experience, for example, by providing positive feedback. (6) The system should be pro-active and suggest activities to the users.

In a second step, user characteristics in the use of ICT-based social media were identified. These user characteristics included (1) motivation for ICT use and different user gratification types, (2) openness to ICT usage, and (3) openness to new social contacts.

Concerning the findings on usability and user acceptance, the workshops and interviews indicated that ease of use was reported to be quite high among almost all end-users. The emotional quality of interacting with as well as handling the tablet was rated by the majority of the end-users as positive or at least neutral. Also, the 7-inch tablet seemed to be acceptable in terms of size and weight ("just about right"). Concerning the observed (and thus more objective) ease of use, several components of the prototype seemed to require initial training. For example, the coach message can be repeated by pressing a "repeat" icon. Most subjects did not notice this icon. The instructions of the coach – although already adapted to the needs of older people – were still perceived as quite difficult. Handling the touchscreen was new to almost all the participants and was also observed to be difficult and non-intuitive, as in all cases it required initial explanation.

4. Conclusions

The empirical results of gaining knowledge on user requirements in ICT-based social media use indicated a general openness to ICT use among older users who actively seek to widen their networks. The findings on usability and user acceptance of the prototype system showed at least moderate acceptance, provided that the user receives both a short initial training phase and constant support during the system testing. The next steps in the project will be to feed back these results into the design process as well as to implement social functionalities and to implement content in the friendship enrichment programme.

Aside from the potential benefits of using social media, the potential barriers to ICT use might include specific user characteristics like frailty, cognitive impairments, and reluctance to use ICT. These characteristics might be particularly present in our target group of older people living in assisted accommodation. Also, the real-life living arrangements as well as the user's social network have to be taken into account to make the system successful. We conclude with three lessons-learned in facilitating use of ICT-based social media by older people: (1) Constant end-user involvement through user-centred design and implementation, (2) Constant support and training when the system is in use, and (3) User awareness regarding the users' social networks and physical environment to facilitate the transfer between virtual and real world.

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THE RISE OF THE SILVER SURFER: WEB 2.0 PARTICIPATION BY SENIORS

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Summary

With Web 2.0 as the evolution from a "read-only" World Wide Web towards web sites and web services based on participation, intercreativity, collaboration and sharing between users, it is obvious that the World Wide Web plays an essential role in all e-inclusion projects. One of these projects is Third Age Online, which strives to motivate and activate seniors to participate actively in these new Web 2.0 possibilities.

This paper recapitulates the key concepts of Web 2.0 and described its possibilities in better participation, more intercreativity and e-inclusion. Next to that we elaborate on the participation of elderly people on the World Wide Web in general and more specifically on several Web 2.0 communities, namely SeniorWeb Netherlands, Wikipedia and the Free/Libre/Open Source Software Developers.

While analysis of the member database of SeniorWebNL shows that few seniors are using the possibilities of and are actively participating in Web 2.0 services, the re-analysis of the Wikipedia Survey and the FLOSSPOLS Developer Survey show that in these intercreative communities seniors are more active participants in contributing to Wikipedia and developing OS/FS. At the same time the Third Age Online project aims to develop methods and measures for motivating older persons to participate in online communities and with these results we can see that seniors even form a Web 2.0 elite within existing communities.

1. Introduction

In 1989 Tim Berners-Lee invented the World Wide Web and shared a vision together with colleague Robert Cailliau, that the "dream behind the Web is of a common information space in which we communicate by sharing information. [1]" This dream came true in the so-called Web 2.0. Nowadays, the internet as a common information space is part of our daily life. Where younger people are raised with all kinds of new media, seniors might be left behind and unheard in this next stage of the information society. The European Commission has adopted e-inclusion as one of the prominent features in the Digital Agenda for Europe. Within this framework, the European

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project Third Age Online is also committed to activating and mobilizing seniors for Web 2.0.

2. Third Age Online

e-Inclusion focuses on better online participation, more online collaboration and adding user-generated content, i.e. everything Web 2.0 stands for, and applies this to several target groups. One of these target groups is seniors, which is also the target group of the European consortium project Third Age Online (TAO).

Modern information and communication technologies offer us the possibility to engage in social interactions more frequently online, to move a share of our social contacts to the internet and to use the framework of online communities to participate in processes of value creation. There are many indicators that, for a number of reasons, older persons use these opportunities only partially and underestimate the opportunities that ICT has in store for them. What is more, online communities are striving to involve more persons over the age of fifty years in their volunteer activities and are determined to use older persons' diverse experiences and competencies more efficiently.

"Tao" (Chinese for way, method) is not only a placeholder for the Chinese ideograph, but also an acronym for "Third Age Online" [2]. The main target of the project[2] is to highlight the ways in which the access of older persons to the opportunities offered by online communities can be facilitated. At the same time, the project aims to profit from the growing number of older persons to advance charitable projects of online communities.

Two kinds of online communities are at the centre of attention: On the one hand partly goal-oriented senior communities such as SeniorWeb Switzerland and SeniorWeb Netherlands, on the other hand goal-oriented Wikimedia communities with a mixed target group.

The main focus of the project is on two important challenges that pertain to the enhancement of older people's participation in online communities:

- To develop effective methods and measures for motivating older persons to participate in online communities and for fostering the intergenerational integration of these communities.
- To adapt the design of the user surfaces and the functionalities of online platforms to the specific needs of older persons (all the while considering the needs of the existing community).

[2] TAO will run from October 2010 to October 2013. The project consortium consists of, amongst others, research partners Maastricht University, Bern University of Applied Sciences, Ulm University and community partners SeniorWeb Netherlands, SeniorWeb Switzerland, WikiMedia Germany and WikiMedia Switzerland.

TAO can be expected to enhance older persons' social integration and especially participation in the information society (e-inclusion), which in turn is supposed to have a positive effect on older persons' general well-being. For the first year of the project we will do an analysis of the current Web 2.0 participation of seniors. This will be elaborated in the next paragraphs.

3. Results: The Rise of the Silver Surfer

In this part we will elaborate on the Web 2.0 participation of seniors. For this, we will use the quantitative analysis of the member database from the Dutch project partner SeniorWeb, an organisation that wants to stimulate participation and self-development of all seniors in the information society. In addition, the data of two existing online surveys of the world's largest online intercreative collaboration communities will be re-analysed. The FLOSSPOLS Developer Survey provides information on Free/Libre and Open Source Software developers and the general Wikipedia survey provides deep insights into usage and contribution patterns of Wikipedia.

From the member database, we could not only analyse demographic information of the current members, but also and more importantly their use of several web contact possibilities offered by SeniorWebNL through their website. These possibilities include mailing lists, a forum and Trefpunt, a feature similar to Facebook and other social networking sites. For the analysis of SeniorWebNL's member database we formatted and merged several databases into one single database. The collected data were then processed in SPSS.

The member database had 114,000 members at the moment of analysis. This database (with geographical and demographic information) was combined with the user databases of the mailing list system, the forum and Trefpunt and also the archives of the PC assistance database. For the analysis we made a distinction between active users (web contact possibilities) and passive users (PC assistance), since PC assistance only requires users to fill in a form whereas the web contact possibilities fulfil the Web 2.0 concepts of participation, collaboration and creation.

Looking at the amount of members using SeniorWebNL's online features, it is interesting to see that most members are using the PC assistance possibilities, either by e-mail or at home (see Table 1). The active web contact possibilities all cover approximately 5000 to 7000 members, but of course several members might be using more web contact possibilities at once. When taking this into account, we calculated that 13,960 members (12.2 %) are active users of the SeniorWebNL web and contact possibilities (see Table 2).

Table 1. SeniorWebNL: Usage by online feature

Online feature	Number of members using it
Mailing lists	6 923
Forum	4 917
Trefpunt	6 223
PC assistance by mail	24 023
PC assistance at home	12 388

Table 2. SeniorWebNL: Amount of web contact possibilities used

Number of web contact possibilities used	Number of members
One	10 522
Two	2 773
Three	665
Total	13 960

Of course one must realize that the core business of SeniorWebNL is to stimulate participation and self-development of all seniors in the information society, mostly through offering PC assistance online and at home, and their web contact possibilities are only optional features for the members. However, it is typical to see that even in the SeniorWebNL member database only a minority are using the offered Web 2.0 features.

One of the best known examples of both "users add value", peer production and co-creation as the intercreative contribution of "prosumers" and "produsers" is Wikipedia, the online encyclopaedia written entirely by Internet users. For this paper we re-analysed the first-ever comprehensive Wikipedia survey [3], which ran between 2007 and 2010. This survey was conducted worldwide in several languages and the dataset that has been used for this article contained 176,192 cases.

Table 3. SeniorWebNL: Age groups among survey participants

Age	Number	Percent
10–49 years	167,021	94.8 %
50–59 years	5,995	3.4 %
60+	3,176	1.8 %
Total	176,192	100 %

Despite the fact that there were thousands of participants in the survey, only 5.2 % were 50 years of age or older and even only 1.8 % fell into the 60+ years group (see Table 3). The amount of participation, though, is not affected in these senior groups. Among the participants, the Wikipedia users aged 50+ and 60+ are even more active in contributing to Wikipedia than other age groups (see Table 4). These senior contributors, who are among others writing, checking and editing articles, can be considered as a Web 2.0 elite force for their age. This way, Wikipedia is already a community that profits from the growing number of older persons and the online encyclopaedia is thus able to advance its online intercreative collaboration project.

Table 4. Wikipedia: Activity by age group

	Age groups			
Activity	**10–49 years**	**50–59 years**	**60+**	**Total**
Contributors	30.5 %	35.8 %	31.9 %	30.7 %
Ex-contributors	2.5 %	2.3 %	2.0 %	2.5 %
Readers	66.2 %	60.4 %	63.8 %	65.9 %
Other	0.9 %	1.5 %	2.4 %	0.9 %
	100 %	100 %	100 %	100 %

Analysing the non-contributing group of seniors (60+ years), one can see the reasons for non-contributing and the possibilities of starting to contribute. Most seniors apparently think they do not have enough information to contribute, or are happy to just read Wikipedia and do not have an urge to write any articles. Simultaneously they would be much more likely to contribute to Wikipedia if they were more aware of specific topic areas that needed more involvement in the contribution process or when it was clearer that people would benefit from their efforts.

A final data input will be given by the re-analysis of the FLOSSPOLS Developer Survey. The FLOSS (Free/Libre/Open Source Software) project [4] resulted in the single largest knowledge base on open source usage and development worldwide. The FLOSSPOLS Developer Survey provides information on Free/Libre and Open Source Software developers. Again in this survey, we see a minority (1.4 %) of the participants are 50 years or older, but this senior minority is more active than younger survey participants and clearly have the same use of open source and/or free software (OS/FS) as younger participants (see Tables 5, 6 and 7).

Table 5. FLOSSPOLS: Age groups

		Number	**Percentage**
Part.	**Younger developers (> 50)**	2368	98.6 %
	Seniors (50+)	34	1.4 %
Total		2402	100 %

Table 6. FLOSSPOLS: Hours per week spent in FLOSS development

Participants	**Average hours per week**
Younger developers (> 50)	2.81
Seniors (50+)	3.38
Total	2.82

Table 7: FLOSSPOLS: Use of OS/FS at work, university or school

		Younger developers	Seniors
	1 Yes	95.0 %	94.1 %
	2 No	5.0 %	5.9 %
Total		100 %	100 %

When looking at the reason for contributing to the open source movement and developing, most seniors give the same reasons as younger participants. Only a few reasons show significantly different results. It seems that less seniors develop OS/FS to learn and develop new skills or because they want to improve the OS/FS products of other developers, compared with the OS/FS developers younger than 50 years old. On the other hand, more senior developers seem to develop and use the OS/FS community to get help in realizing a good idea for a software product.

4. Discussion

With Web 2.0 as the evolution from a "read-only" World Wide Web towards web sites and web services based on participation, intercreativity, collaboration and sharing between users, it is obvious that the World Wide Web plays an essential role in all e-inclusion projects. One of these projects is TAO, which strives to motivate and activate seniors to participate actively in these new Web 2.0 possibilities.

This article introduced the key concepts of Web 2.0 and described its possibilities in better participation, more intercreativity and e-inclusion. We then elaborated on the participation of elderly people on the World Wide Web in general and more specifically in several Web 2.0 communities, namely SeniorWebNL, Wikipedia and the Free/Libre/Open Source Software Developers.

While analysis of the SeniorWebNL's member database shows that few seniors are using the possibilities of and are actively participating in Web 2.0 services, the re-analysis of the Wikipedia Survey and FLOSSPOLS Developer Survey show that in these intercreative communities seniors are more active participants in contributing to Wikipedia and developing OS/FS. At the same time the TAO project aims to develop methods and measures for motivating older persons to participate in online communities and with these results we can see that seniors even form a Web 2.0 elite within existing communities.

Based on these results more research is needed into the barriers and drivers of Web 2.0 participation for seniors. Why are seniors not making use of Web 2.0 and why are the already active seniors in the Wikipedia and FLOSS developer communities so active? Strategies and measures should be developed to activate and mobilize seniors to participate in Web 2.0 to create this Web 2.0 senior elite for all online communities.

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INTERGENERATIONAL ACTIVITIES SUPPORTING THE RELATIONSHIP BETWEEN GRANDPARENTS AND GRANDCHILDREN THROUGH ONLINE ACTIVITIES

Verena Fuchsberger[1], Christiane Moser[1], Manfred Tscheligi[1]

Abstract

The FamConnector project seeks to find possibilities for elderly people's social interaction based on an internet platform, which goes beyond online communication. The aim is to create online activities supporting interaction and communication that grandparents and their grandchildren will enjoy together. In the requirements analysis phase, elderly people were invited to take part in workshops, interviews and a survey to tell about their preferred activities with their grandchildren. The assessed intergenerational activities can be summarized by the following overall categories: (1) indoor activities (e.g., painting and drawing, doing handicrafts or playing), (2) outdoor activities (e.g., walking, hiking, cycling), (3) excursions (e.g., visiting a zoo), (4) everyday activities (e.g., cooking and baking, gardening or eating together) and (5) others (e.g., telling grandchildren how to do things or imparting values). The identified activities in the different categories have then been investigated for their potential for online social interaction. Furthermore, end users were involved in an initial evaluation of the prototype of the platform. The most important insights of this evaluation will be presented in the second part of this paper.

1. Introduction

Social interaction, especially staying in touch with younger family members, is crucial for older people's well-being. According to Vutborg et al. [7], older people may feel revitalized when a grandchild joins the family. Different studies (e.g., [1] and [4]) identify joint activities as a major component of grandparent-grandchild relationships. However, as grandparents nowadays often live geographically distant from their grandchildren [7], there might rarely be a chance to conduct face-to-face activities together. Therefore, this paper aims to investigate the transfer of offline activities to online environments, as they are more flexible in terms of location and time. Within the Ambient Assisted Living project FamConnector (funded by the AAL Joint

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Programme), which aims to facilitate the relationship between grandparents and grandchildren aged three to nine years through online interactions (i.e. communication and activities, like reading a book together or playing a game), we investigated elderly users' requirements in order to develop appropriate online activities and conducted an evaluation of the prototype to find out whether the platform meets the grandparents' needs.

At the beginning of this paper, we describe the study setup of our user requirements analysis, the results regarding offline activities that are conducted together by grandparents and grandchildren and we will present three examples of joint activities, which are appropriate for an online environment as well. Afterwards, the evaluation and the respective results are illustrated.

2. Related Work

Due to a rising flexibility in living situations, the geographical distance is often increasing between seniors, their children and grandchildren. Thus, it is harder to develop and maintain a close relationship, especially between grandparents and grandchildren [7]. Additionally, in face-to-face conversations joint activities are often addressed [3], which rarely occur if the grandparents and grandchildren are geographically separated. Evjemo et al. [3] found that, that due to a lack of a common context, remote communication (e.g., by phone) between grandparents and grandchildren is typically infrequent and of short duration. Furthermore, Vutborg et al. [7] found that "grandparents and grandchildren are keen to stay in contact and that this can be facilitated through 'conversional context' in the form of joint story telling involving fictional stories" [7]. Therefore, taking offline activities as a basis for designing online activities is highly relevant. Mahmud et al. [6] stated that current online games often deviate too much from games that older adults are familiar with. Thus, the success of online activities will depend on how accurately the offline wishes and needs are assessed to be best transferred to online environments. In the following we will present, how we assessed those needs and wishes, the respective results regarding intergenerational activities and an initial evaluation of how those needs have been met so far.

3. Requirements Analysis

According to the aim of the FamConnector project we focused on grandparents with grandchildren between three and nine years. Within the project a user-centered design (UCD) approach is applied, which is understood as collaboration between designers and users [8]. Within this paper we will focus on insights about intergenerational activities, as they are an integral part of the web platform FamConnector.

3.1 Study Setup

The following research questions were investigated within the analyses phase:

RQ1: Which activities are conducted together by grandparents and their grandchildren offline?
RQ2: Which offline activities are suitable to be transferred to online environments?

Therefore, the following methods were applied:

Workshops: Four workshops with a total of fifteen grandparents were conducted in Austria and Switzerland, focusing on intergenerational communication and offline activities that are preferably conducted between grandparents and their grandchildren.

End User Interviews: The interviews (n=11) were conducted in Austria and Switzerland and also addressed grandparents. The results of the above-mentioned workshops served as a basis for the questions of the interviews. Thus, the interviews aimed to intensify the conclusions of the workshops and to clarify inconsistencies.

Survey: A survey including offline and online questionnaires (n=301) was distributed to grandparents in Austria, Switzerland, Finland, and the UK. The survey focused on the interaction between grandparents and grandchildren including questions on intergenerational communication and joint activities.

Expert Interviews: Ten expert interviews (five in Austria, five in Switzerland) were conducted to investigate the children's perspectives on their relationship with grandparents and preferences for joint activities. Therefore, teachers, psychologists, educational scientists, etc. were interviewed, all of them having expertise in children aged between three and nine years.

3.2 Activities and Categorization

The workshops and the interviews were analysed qualitatively by coding and summarizing the statements (following a grounded theory approach [2]). The survey consisted of quantitative data on activities (e.g., frequency of pre-defined and preferred activities). In total, the involved grandparents and experts mentioned 55 different activities, which were categorized to get a better overview. The categories and selected activities will be presented in the following.

Indoor Activities: The most frequently mentioned indoor activity for grandparents and grandchildren was painting and drawing. Similarly, but less frequently mentioned, are handicrafts. Furthermore, playing has an important role, e.g., board, card or computer games. Singing and making music seems to be a rather special activity for some grandparents and their grandchildren, but not all of the participants liked these activities. One joint indoor activity is watching TV, however, it might rather be a method for occupation than for explicitly spending time together.

Outdoor Activities: Often mentioned outdoor activities were walking, hiking or cycling, however they are sometimes limited by the grandparents' physical condition (e.g., illness, accidents). Playing as another outdoor activity is mainly conducted in the garden, on playgrounds etc. Some grandparents and grandchildren enjoy recreation in the open air, where grandparents are often talking to their grandchildren about nature (e.g., animals, trees, plants).

Excursions: Although excursions are mainly outdoor activities, a separate category was made because excursions are connected to specific events or objects (e.g., theatre, fun parks). Going to the zoo or wildlife park was mentioned often. Nevertheless, excursions are rather infrequent activities and the importance might therefore be overestimated. Many grandparents would also appreciate sightseeing and travelling together with their grandchildren, but only a few can conduct this activity due to financial or physical reasons.

Everyday Activities: Activities, which refer to everyday life or daily routines, were mentioned frequently. Grandparents and grandchildren cook or bake and eat together, clean up, garden, iron or work with the PC. They conduct these activities together according to the grandparents' usual daily routines. Furthermore, talking was explicitly mentioned as a joint activity, the topics include football, animals, school, etc.

Others: Activities between grandparents and their grandchildren are often characterized by a specific kind of teaching. Although the participants did not envision themselves as teachers or educators, it is important for them to tell the children how to do things (e.g., how to play certain games, how to carve a ship out of a block of wood, how to make jam, how to plant potatoes, how to cook, how to use the computer, cars, etc.).

3.3 Offline Activities to be Transferred to Online Environments

In a second step, frequently mentioned offline activities were investigated for their potential to be transferred to an online environment. The following questions were used to identify the possibilities of each activity to be used online as well: (1) Is it possible to delimit the activity from nature or the real (i.e. physical) world? (2) Were the findings for this activity consistent? (3) Does the activity address a wide user group concerning its characteristics (e.g., socio-demographic or religious aspects)? (4) Is it possible to combine the activity with another one?

Several activities were regarded as being unsuitable for online settings, as they cannot be implemented due to their bond to the physical world (e.g., recreation in the open air, horse riding), others were appraised very ambivalently by the end users (e.g., visiting an exhibition). Furthermore, single activities might be combined into one online interaction, e.g., collecting things like leaves and doing handicrafts. In the following, we will present three example activities that proved to be suitable regarding each of the questions (1)–(4) and are thus appropriate to be conducted remotely by grandparents and grandchildren in an online environment.

Playing is one of the most important indoor and outdoor activities for grandchildren and grandparents. In the survey 82.5 % of the participants indicated they liked playing together with their grandchildren. Playing does not refer to a specific place and it can be combined with other activities, e.g., learning. Furthermore, it is done by a wide range of elderly people and can be conducted with or without specific materials. Playing online is already possible, e.g., in form of multiplayer games, which are "…a new kind of involvement of the player" [5], but there are few online games suitable for two different generations. However, offline gaming is experienced as a means for social interaction and enjoyment [6], thus, online games need to clearly address the social interaction to fit the intergenerational setting.

Doing handicraft work and building things seem to be very important for grandchildren and their grandparents as an indoor activity. Jointly created artifacts support the feeling of connectedness and grandchildren enjoy learning how to do things from their grandparents. Handicraft work is mostly not limited to a certain place or user group and can be combined with other activities (e.g., connect invented stories with the things made). A very important part of this activity is the possibility of storing and sharing the created artifacts; one end user even mentioned having a gallery at home, where they exhibit the objects.

Learning and tutorials is an example within the category "other activities". Especially in the workshops there were many references to learning, e.g., grandparents often supervise or help their grandchildren with homework, learn for exams together or test them. Children enjoy grandparents' patience, which their parents sometimes lack. According to the experts, all learning activities should be playful to be successful. Thus, it would be possible to offer an online quiz for learning, e.g., the grandparent is a quizmaster who asks her/his grandchild, and they could interchange after one made a mistake. This activity is also not limited to a certain space or user group and can be combined with playing.

4. Evaluation phase

In order to find out whether the end users like the first two activities on the platform, i.e. reading a book together and playing a game, grandparents evaluated the platform. The evaluation of the system is done iteratively (i.e. there are several evaluations in the different development phases), the following study setup and results refer to the initial evaluation of the prototype. While the final evaluation will be conducted in the form of a field study in 2012, the prototype was evaluated in a usability laboratory in Austria and with a mobile usability lab in Finland.

4.1 Study Setup

A target group (ten grandparents in Austria and ten in Finland) was invited to evaluate the platform regarding its usability, aspects of user acceptance and user experience. A control group, consisting of ten younger people, was also invited in order to figure out specific characteristics and needs of elderly users. The results were analysed quantitatively and qualitatively. In the following, a summary of important insights is presented regarding the willingness to use a web platform and to reveal personal data, as well as regarding user-generated content.

4.2 Selected insights

The end user evaluation of the prototype revealed that…(in brackets: direct quotations from end users)

- the participating grandparents were interested in the web platform as soon as the benefits were clear *("One takes part in the children's life and is able to bond with the grandchild, e.g., through reading a book together.")*.
- the participating grandparents would be willing to reveal personal data, if the data is handled carefully. The participants e.g., referred to existing social networks and criticized the necessity of revealing many personal data there (*"On Facebook there are some issues, which are not good, e.g., that they are requesting a lot of personal data already during registration."*).
- the participating grandparents were willing to try the web platform, but emphasized the importance of basic computer skills, which not all of them have (*"I would need to learn a lot before I could effectively use the platform."*).
- the participating grandparents did not explicitly require to generate their own content, but some of them would appreciate being able to express themselves on the web platform, e.g., by uploading photos into the user profile, or to individualize the interaction, e.g., by uploading favourite books and games into the activity zones (*"It would be good to upload games myself, as my grandchild likes one certain game best."*).

5. Conclusion and Discussion

The aim of the web platform FamConnector is to facilitate the relationship by connecting grandparents and their grandchildren as well as by providing fun and shared experiences. Regarding RQ1 (activities grandparents conduct together with their grandchildren offline) five categories were identified: outdoor activities, indoor activities, excursions, everyday activities and others. All these activities were then investigated for their potential to be transferred to online environments (RQ2). Some activities cannot be implemented due to their bond to the physical world, or they were appraised ambivalently by the end users or they are too specific for one user group. In order to illustrate activities which could be transferred to online environments according to our four criteria questions, three examples were described. The second part of this paper briefly described the first evaluation of the prototype including the study setup and relevant insights.

Although there are some barriers when developing online platforms for elderly (e.g., little confidence in or no computer skills, uncertain benefits), there are great opportunities as well, which are recognized by the elderly. The grandparents we involved in our research were very much interested, and they appreciate the possibility to interact with their grandchildren online, even more if the offered activities conform with those they preferably conduct offline as well.

Acknowledgements

This research was enabled by the FamConnector project (funded by AAL JP). Special thanks go to end user organizations, which supported us in conducting the studies.

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PLAY WITH YOUR LIFE: PREVENTIVE IMPACT ON WELLBEING OF ELDERLY THROUGH AAL BASED SOLUTION

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Abstract

This paper describes the development of the Ambient Assisted Living (AAL) prototype ‘Play With Your Life’ (PWYL), an ICT-based solution to the very challenging issue of preventing the internal experience of loneliness, as this is strongly associated with dissatisfaction with life. The work presented has been tested in four European countries. The goal of PWYL is to stimulate and enable interest-based connections and communication among elderly people and others and thereby empower them and enrich their life. Experiential expertise is gathered by involving the target group from the start of the project, following a living lab approach. A mix of methods has been applied, such as RealPlay, ethnographic study and co-creation workshops to gain better insights into the specific user-groups of ‘the elderly’ and to make sure the technology developed is meeting the needs of the potential users.

Keywords Ambient Assisted Living, ageing, ICT, eHealth, serious gaming, living lab

1. Introduction

The ageing European society faces social consequences since the oldest part of the population especially is at risk of becoming isolated and lonely, as they grow old and their work-related networks erode, as well as the higher risk of losing dear ones or ‘losing oneself’ to different kinds of illnesses. In those cases growing old may imply depression and an increased risk of dementia [1]. Feelings of loneliness significantly predict important clinical endpoints – cognitive decline and institutionalization – of elderly individuals during a 10-year follow-up. An inactive and socially isolated life has serious negative consequences for both the elderly and the rising costs associated with health care in society. Not only the number but especially the quality of the contacts is crucial. The association between life satisfaction and quality of social

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contact may explain three to four times more variance than the association between life satisfaction and social contact quantity [2].

The tendency for more elderly people to remain in their own homes instead of living in retirement or residential homes has created an opportunity for developing a game as a tool for social interaction, targeting independent elderly people living at home. PWYL is a new flexible solution for the integration of specific national and regional content and integration of principles for use of social media and community building. In order to develop a profitable and sustainable solution the PWYL project involved primary, secondary and tertiary users throughout the process, and their different perceptions guided the direction of development of the concepts. The primary users are the end-users, secondary users refer to relatives and caregivers, and tertiary users are the senior representatives from the public sector.

Storytelling and self-expression can be the starting points for social connectivity. The Storytable is a successful ICT-application developed in the Netherlands [3]. This user-friendly interface is developed for and with elderly people to share stories and interact with each other. The core of the Storytable is a database of audiovisual material from the 1920s to the 1980s. It is used in institutional care facilities for elderly, now around 100 retirement homes in the Netherlands. Research shows the positive effects of the Storytable: it increases the quality and enjoyment of life in retirement and residential homes. The users feel more positive about themselves, experience greater self-confidence, feelings of depression are decreased and they feel more connected. Additional benefits of the Storytable are decreased social isolation and improved memory [4, 5].

PWYL is based on the principles of the Storytable; it is an AAL technology that supports and deepens existing social relations. PWYL builds on the idea that in storytelling and reminiscing people re-establish their identity and relationships that are empowering them. A demonstration version of the game has been developed for initial evaluation with users. Furthermore, PWYL connects to a virtual community that supports and stimulates online activities. The aims of this community are to support: new learning, new like-minded relations and reconnecting to older relations, proficiency and competences (possibility to dig into specific areas of interest and make use of or improve skills related to storytelling). The technological choices (tablet/ iPad /community) allow opportunities for innovative design and new metaphors.

The project integrated the individual and societal level with the commercial perspectives in four European countries; Denmark, Finland, the Netherlands and Sweden. The northern countries are frontrunners and leading societies in utilizing ICT-based services and businesswise they provide a very credible business innovation ecosystem for the development and dissemination of PWYL:

(1) At an individual level PWYL aims at helping people to stay active by using their creative potential (former experiences, competences, ways of thinking and working etc.). PWYL provides a tool and media for meaningful interaction and for valuing one's experiences by sharing them with peers and the caring community, and thus getting emotional and intellectual stimulation and support;
(2) At societal level more elderly people continuing to live independent, active and satisfying lives in their own homes will have a preventive effect on the predicted rise in costs of health and long-term care, through a decrease in the need for professional help, lowering the risk of dementia and other health related costs in the public sector.

PWYL provides an opportunity to turn memories into something concrete that helps people to remember the beauty of life and connect the life to come with what has already been. It brings together family members like (grand-)parents, (grand-)children, siblings and cousins; makes social (digital) gaming a way of reinforcing old friendships, promotes inter-generational connections. It further supports people's interests and proficiencies, which are exposed and made subjects for meaningful conversations between people on the same wave length.

2. Methods

"Once designs are thought of as shared communication and technologies as media, the entire design philosophy changes radically, but in a positive and constructive way." [6, p. 67]

The starting point for PWYL was integrating the evaluation of the wishes for additional services, being expressed by the users – both care takers and care givers – and develop AAL concepts of a service, for the rising market of elderly people in their own home at risk of becoming lonely and isolated. The concept offers ways and occasions for communities of users to be created, as it will intensify interaction, communication and dialogue between the users and contribute to the feeling of well-being, self esteem and belonging.

Through co-creation workshops, as well as in-depth interviews, the scope of the study was to gain insight into the needs and wishes of the elderly, in relation to improving social interaction through AAL [7]. The study aimed at addressing the following issues of the PWYL service, namely the stimulation and facilitation of: satisfying relationships; awareness of individual experiences and resources as a prerequisite for participation beyond the closest connections; meaningful involvement in storytelling as an engaging activity, a means of self-expression and an enabler for conversation and social interactions, and the willingness to pay for the product/service.

2.1 Living Lab methodology

Within PWYL four different Living Labs collaborated and shared their expertise and knowledge. In general, the living lab approach translates itself into very different traditions and various types. However, central to the living lab idea is the user as the guarantor for successful innovation and development of a product or service that meets the needs of the users.

2.2 REALplay workshop

The workshops began in April 2010, when participants were selected in four of the participating countries to join a REALplay screenplay, using Lego bricks as a means of supporting the process [8]. The reason for choosing Lego bricks in the first place was to support **the hand-mind connection.** The workshops enabled the participants to overcome the barrier of not being able to define, express and share tacit insights and perspectives from their everyday lives. Secondly, Lego bricks are used to stimulate **a shared language**. The workshops enabled the participants to understand each other's insights and perspectives better through the process of making. Insights were gained in social relations and activities through the first workshop held, but also on 'taboo' themes such as loneliness and (social) isolation. At the end we were better informed about the specific user-groups of 'elderly' and began to understand their particular situation, the needs and wishes related to the specific user-groups, and approaches to the situation that are engaging and meaningful.

Expertise was gained in answer to the questions: What are the challenges to stay socially connected after retirement? How does loneliness occur? To whom does it occur? What do people do to oppose loneliness? What are the barriers to escape it, when it is there?

2.3 Ethnographic insights

Based upon the results of the REALplay workshops, a cross-national ethnographic based analysis was conducted, drawing also on thinking from 'Outcome Driven Innovation' theory. In-depth interviews were held in all four different countries with five informants from each country (n=20); twelve males and eight females participated, ranging in age between 62 and 82 years (average: 69 years). All the interviews took place in the informants' homes from May to June 2010. The interviews lasted from 2½ hours to 5 hours. The aim of the interviews was to gain insight into individual perceptions and experiences of social connectedness. With social connectedness we refer to the experience of belonging and relatedness between people, using 'awareness systems' [9, Figure 1].

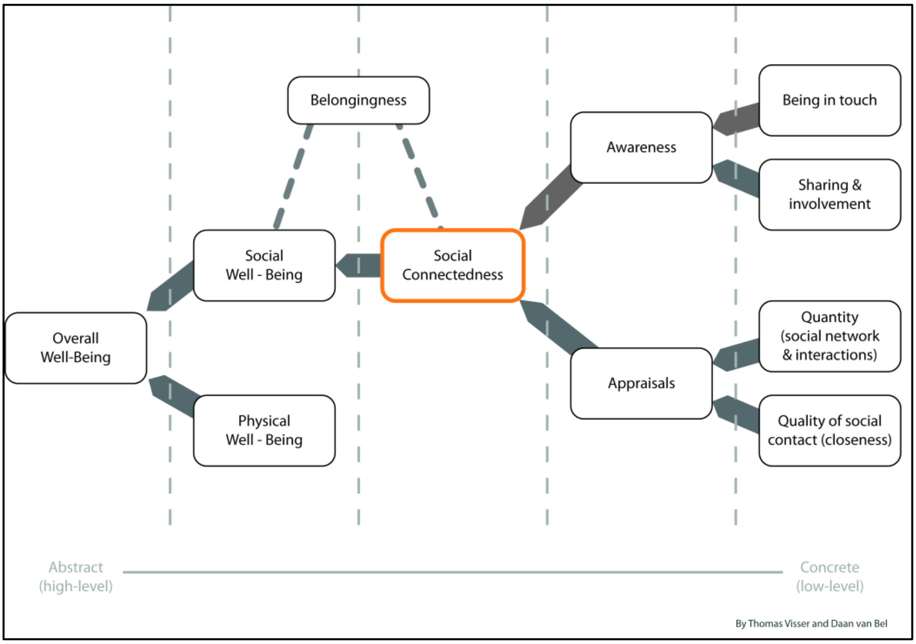

Figure 1: Social Connectedness [9]

3. Results

The qualitative insights, organized into jobs, barriers and desired outcomes, were taken as a starting point for desirable as well as undesirable future concepts. The focus was on the development of scenarios for different personas, built up from the actual participants. Since it is difficult for participants to leap into the future and imagine desirable concepts without being blocked by current barriers of change, co-creation sessions were held to guide the participants. The goal of the workshop was to co-create with potential users five possible concept design directions, all about social connectedness.

Based upon the input of the workshop participants, three 'paper prototypes' were developed, of which PWYL was chosen based upon the fact that the concept: "Supported social connectedness on an individual level; the commercial potential (Is it original? How difficult is it to develop?)" was targeted towards the chosen target group and had the possibility of decreasing the costs in the public sector.

The business partners started to research the business opportunities at the beginning of the project and several international discussions were held on the market potential of the concepts. Based on the feedback of the user groups combined with the market potential, the consortium chose to develop the interactive game within the project.

This approach still holds different possibilities for positioning the solution – the most interesting being the possibility to take a universal game approach, where impact is achieved not by addressing special elderly needs but providing an entertaining game that makes memory of one's own past a resource – a current social currency. The business model canvas approach served as a tool to position the concept business wise [10].

The decision of which concept to choose was taken carefully. The work was organized as follows:

- The concepts were recaptured and SWOT used to elaborate on the concept. This created shared understanding of the concepts;
- A short desk research on market and competition for the two concepts was performed;
- The job categories, innovation tracks and feedback from user workshops was reviewed in relation to PYWL;
- The concept was qualified through a principal description of the concept, an impact break down (theory of change) and a business model sketch;
- The job categories, innovation tracks and feedback from user workshops were reviewed;
- The concept was qualified through a principle description of the concept, an impact break down (theory of change) and a business model sketch.
- Finally implication for the development process was assessed.

3.1 Demonstrator test

To test the concepts with the users (8–10 participants in every workshop), seven workshops were held of three hours each, in Finland, Denmark and Sweden. The aim of the workshops was to provide guidance regarding the pros and cons of the game principles, wish lists concerning functionality, and wants and needs in relation to the concepts.

4. Discussion/Conclusions

Not only the number but especially the quality of social contacts is crucial in fighting unwanted loneliness. AAL technology could play a role in supporting elderly people in improving both the quantity and quality of their contacts and social interaction. Considering the pilot study results, it could be concluded that elderly people find the prototype ‘Play With Your Life!’ (PWYL) of added value to their lives. PWYL supports friends to overcome the barriers that illness or disabilities may constitute; helps establish new interest-based friendships; builds friendships on confidence and closeness; helps people to be attentive to each other and practise social competences; helps deal with frustrations and sadness connected to one's own bodily decline, disabilities or illnesses, and makes memories alive and well and something concrete and shared that helps coping with losses. The observations of the usability tests of PWYL have been outlined, and the decision on which the choice of the concept is based was explained.

The design principles of the prototype of PWYL were described, that enable users to connect and interact socially with their family members, friends and relatives, such as the preliminary findings of the user study. Based upon the input the prototype is adjusted and will be tested in the collaborating countries with the primary, secondary and tertiary target groups so that more reliable conclusions can be drawn on the improvement of social interaction through AAL, by applying a tool such as PWYL.

Acknowledgement

The Ambient Assisted Living Joint Programme has supported this research.

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A SOCIAL REMINISCING SYSTEM FOR INTERGENERATIONAL COMMUNICATION: USER NEEDS ANALYSIS

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Abstract/Summary

The Nostalgia Bits (NoBits) project aims at fostering social interaction between elderly people and their families, through capturing and sharing online their memories, personal, family and local history embodied by letters, newspapers, postcards, photographs and other documents. A web-based platform will be developed where tangible artifacts of an elderly person's life experience can be uploaded and become a significant resource for use by other generations and a means for connecting the elderly users with members of own generation. Here, we describe the main results of a user needs analysis carried out to define the features and functionalities of the NoBits system. The specific objectives of the user needs analysis were two-fold: (a) to evaluate users' perceptions, attitudes and expectations towards the NoBits service concept (social reminiscing system); (b) to collect users' suggestions and ideas towards the key functionalities of the service platform. The investigation involved two rounds of focus groups and interviews with prospective end-users: primary users (seniors >65 years) and secondary users (children <14 years). The first round involved twenty-three elderly people (mean age = 65.83 sd = 6.32) and 310 children (mean age = 11.29, sd = 2.28). The second round, which deepened and refined findings obtained in the first phase, included ten elderly people (mean age = 67.30, sd = 4.30) and eleven children (mean age = 12.45 sd = 1.21). Results showed that the NoBits service concept was well accepted by prospective users and that supporting collaborative reminiscing with social media was perceived as a promising approach to increase cross-generational interactions and mentoring. In particular, the analysis showed that seniors consider Internet-based reminiscing as a potentially pleasurable activity that offers them rich opportunities for communication with peers, relatives and younger generations. On the other hand, children showed great interest in learning about how life was in the past and liked the idea of collaborating with their grandparents in creating digital reminiscences. The interviewees also provided suggestions and feedback to inform the design process and showed a good level of awareness about the opportunities offered by social media.

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1. Introduction

Reminiscing is a pleasurable activity for seniors and it can improve their well being by providing rich opportunities for communication with peers and family. In recent years, there has been growing interest in develop digital systems to support reminiscing for older people (McCarthy et al., 2004). Reminiscence has been defined as "the volitional or non-volitional act or process of recollecting memories of one's self in the past. It may involve the recall of particular or generic episodes that may or may not have been previously forgotten. This recollection from autobiographical memory may be private or shared with others." (Bluck & Levine, 1998). Social interaction between elderly people and their families could be fostered through capturing their memories as well as personal, family and local histories embodied by letters, newspapers, postcards, photographs and other documents.

Our project Nostalgia Bits (NoBits) aims to create a web-based platform; it is funded under the EU Ambient Assisted Living research programme. Tangible artefacts of an elderly person's life experience can be uploaded to this website to become a significant resource for other generations and for connecting the elderly users with members of their own generation. In particular, the NoBits system will allow users to connect with at least three interacting context groups:

- Network of lifetime (work, interests, education, etc.) platform: allows seniors to reconnect with lost or unknown acquaintances.
- Family and friends platform: facilitates internet-based connection with the user's own family and friends.
- Community and society platform: allows elderly users to provide valuable experiential knowledge and insight to learners not only in terms of modern history but also in terms of the experience gained during their working life.

The collective memories shared through the Nostalgia Bits platform supplies a valuable historical resource as well. Here, we describe the main results of a user needs analysis carried out to define the expectations for the NoBits system.

2. Methods

In the first phase, the sample of elderly people taking part in the focus groups composed of twelve males (mean age = 66.58, SD = 5.3) and eleven females (mean age 65.91, SD = 7.5; total sample mean age = 65.83, SD = 6.32). In the phase of investigating the contents of memories and the reminiscing process, twenty-seven participants (14 male, 13 female) completed the questionnaires. Some of them belonged to the focus group sample. The age of participants was divided into three categories; 55 to 65 years (44.4%), 65 to 75 years (37%), and 75 to 85 years (18.6). All participants lived in the Milan urban area. In this first phase, the children sample consisted of 160 female children (mean age = 11.83, SD = 2.63) and 150 male children (mean age = 10.72, SD = 1.67; total sample mean age = 11.29, SD = 2.28) from different classes and educational institutions in the Milan urban area.

The second phase of our work involved smaller samples: ten elderly people (6 male and 4 female, mean age = 67.30, SD = 4.30) and eleven children (8 male and 3 female, mean age = 12.45, SD = 1.21) who participated separately in four focus groups, two designed for elderly people and two for children. During these groups they had to fill in a questionnaire with the help of a researcher. The questionnaire was a list of items related to specific technical issues: subjects had to indicate the usefulness of the suggested features by scoring from 1 (completely useless) to 7 (very useful). They could add personal opinions on a blank space under each item.

Focus group guidelines were discussed with the partners of the project to create a set of questions that the psychologist could use to lead the discussion among the elderly. The same method has also been adopted to create the questionnaires. The background ideas for our tools were derived from a preliminary set of interviews with communication experts conducted in different countries involved in the project.

Regarding the second phase, the questionnaires for elderly people and for children were slightly different in order to avoid inquiring about issues not suitable for the specific target, e.g., only the elderly were asked about the use of a digital pen to insert memories on the Web and only children were asked about the link between our website and their private social networks accounts.

To better explain technical devices, which are not so easy especially for elderly people, a helpful PowerPoint presentation was created. It showed all the features investigated through the questionnaire (i.e. what a slideshow is, where comments and ratings could be displayed if implemented on the web platform, the difference between blog and forum).

3. Results

The most interesting data concerns the relationship between elderly people and children, and their attitudes towards the main features of the website. Here, we briefly summarize the main findings from the first phase and the most relevant suggestions yielded through second phase's questionnaires. Concerning the frequency of grandparents and grandchildren talking together, half of children (52.7%) indicated that they speak with their grandparents daily. This percentage increased to 87.7% weekly. The results show a general satisfaction, as 68.8% of children reported that they enjoy and only 3.2% of children state they do not enjoy talking with grandparents. Cross-tabulation with age ranges showed a significant chi-square value ($\chi 2 = 10.533$, $p < .05$), underlining that satisfaction decreases as age grows.

Specific items on the questionnaire yielded interesting suggestions both about the way of producing artifacts for the website and also about technical issues.

- The highest ranked value is the item "create photo album and/or slideshow of artefacts together" (M = 6.60, SD = .669) in the elderly people's questionnaire. Children scored a bit lower (M = 5.64, SD = 1.027) but still valued this item. We can thus state that both the elderly people and children in our sample would like to work together on artefacts. During the discussion, the elderly stated mainly that they want to collaborate in order to be helped by the children.

- Working together with peers is highly appreciated by the elderly (item "create slideshows of specific past events based on artefacts with involvement of peers" had a mean rating of 5.60, SD = 1.58). Therefore, a scenario could be hypothesized where elderly people together build some reminiscence artefacts (maybe during senior centre meetings), which children could later find on the NoBits website.
- Children also like working with their peers (M = 6.45, SD = 0.52), so a working scenario is suggested where groups of children listen to the reminiscences of elderly people and later they work together (based on notes, photographs) to upload artifacts to the NoBits website.

We may state that these three application scenarios show both the will to building something together by sharing memories between the two generations and the joy of working on memories with peers.

As concerns the issues related to the creation of a virtual community, e.g. through comments and ratings, the elderly totally disagreed with the item "Allow rating of others' artefacts" (M = 2.10, SD = 1.44) because they believed that memories just cannot be judged. The lowest ranked item among the elderly was, "Allow the creation and editing of memory content by family and/or close friends" (M = 1.75, SD = 2.12). In the discussion, older people expressed their ideas clearly, saying that allowing editing of others' memories could start "an endless process of mutual changes." Despite these low scores, the elderly like the idea of getting in touch with people who share similar memories. Item "Allow establishing a connection to/network with owners of similar memories (based on time, location, event etc.)" had a mean rating of 5.70 (SD = 0.94), which interestingly shows the elderly will to collaborate and create networks with people sharing similar memories. The elderly stated that identifying' common characteristics of memories could be enough to get in touch with their respective authors. Children's ratings about social network issues were not as high as we expected ("Enable comments on postings": M = 5.36, SD = 1.03; "Allow rating of others' artefacts": M = 5.18, SD = 1.94). Children could have appreciated these issues more, as they are strictly related to their way of surfing the internet. The high score (M = 6.18, SD = 1.4) on the item, "Connect to popular social networking sites to allow transfer of notification and comments, and to extend interaction and contact base (i.e., Facebook; what is happening to me and my shared memories in NoBits, let me invite friends from these sites to use NoBits etc.)" is worth noting. We see that children would really like to connect their NoBits activities to their social network accounts and share them with friends. We could then hypothesize that the preferred scenario – for children but also for elderly people (and maybe even for website administrators) – should be the one through which comments and ratings of artefacts would be allowed only on the social networks where children decide to share NoBits contents.

The last part of the questionnaire aimed at exploring new marketing devices, such as creating a mobile version of the website or using a digital pen that would allow the elderly to write their memories more easily. As predicted, there is wide scepticism ("Allow the creation of artefacts via mobile phone": M = 2.44, SD = 2.6) among the elderly towards a mobile version of the NoBits website. Most of them use mobile phones only to make phone calls. We should notice the high standard deviation for this item, however. In fact, some elderly people rated these innovations as useful, although they are not able to use them. Even children did not seem too enthusiastic about the mobile version of the NoBits website (M = 5.55, SD = 1.63). Some even said that it would make them feel uncomfortable. In Italy, children do not yet seem to surf the internet through mobile phones, at least not the children in our sample. In the discussion, children stated that they would like to take pictures via mobile camera and upload them instantly to the related memories on NoBits website.

The results showed a general agreement with item, "Allow downloading (CD), book, or diary-like structuring and printing of memory compilations" (elderly M = 6.2, SD = 1,47; children M = 6.00, SD = 1.34). This feature seems to represent the link between typical memory collections and our project by giving user the facility to simply create a concrete object that they could manage offline. Concerning the digital pen, the mean rating was 5.00 (SD = 1.05 for elderly; children were not asked this question because they do not belong to our commercial target) and the brief discussion that followed highlighted that the use of a digital pen is interesting, useful, and helpful although not currently a real need.

4. Discussion/Conclusions

Reminiscence seems to be a pleasurable activity for elderly people. They think it is useful, and they are aware that they can help future generations through their memories. Developing a website to create a network where both users can meet and share memories is a fascinating challenge. Our study provides an insight into the elderly and children's attitudes and needs in order to identify the main contents and the technical features of our future web platform.

The elderly share memories spontaneously with peers, family, or even strangers, although in the latter case, they choose to avoid personal details, especially at the beginning of the sharing activity. They want their reminiscence to remain spontaneous, they do not like scheduled meetings to share memories but they surely appreciate the idea of getting in touch with others' memories. A website is a good idea because it would allow them to pursue reminiscence-sharing on the internet spontaneously, whenever they want or need that.

On the other hand, our secondary users, i.e., children, are interested in sharing memories with the elderly because of the experience they already have with their grandparents. This trend decreases with age because adolescents seem to feel the familiar bond as less strong. These data clearly suggest that the focus should be placed on younger children, for example, junior and junior high school students 12 years of age and younger.

Having found that our hypothesized needs meet identified users' needs, the second round of the focus group helped identify website features that are shared between the elderly and children. Based on the findings, such a website could face certain difficulties because of the structure of a social network. Elderly people and children alike do not want memories to be rated and they would like to avoid comments on such a website. Probably the best way to proceed is the one suggested and appreciated by children, that is, connecting the website to popular social networks to allow transfer of notification and comments and to extend interaction and the contact base.

The main methodological difference between our two samples – elderly people and children – is the structure of the questionnaire used in the first round of focus group discussions. Whereas children could write their preferences/suggestions for almost every item, the elderly respondents answered only closed-ended questions, choosing among fixed alternatives. The aim was to help them express their views on topics that are probably not so relevant to them, like technology.

Future studies could also investigate gender differences between grandparents and similarity between the two generations in terms of gender. We might expect that boys and girls speak about different topics with respect to grandfathers or grandmothers. At the end of our study, we disclosed our findings to both the elderly people and the children during a series of meetings conducted in school classes, where the children were requested to work together to create the first artefacts. The participants involved in these informal meetings agreed with the findings of our work. In conclusion, we might state that our methodology allowed us to highlight users' needs towards both reminiscence and technology: our effort in collecting suggestions on these topics was essential in order to create a web service where both elderly and children may work together. By matching primary and secondary users' needs we identified the most relevant technical issues to create a social reminiscing system for intergenerational communication.

HOW TO SET UP A WIN-WIN-SITUATION IN END-USER INVOLVEMENT PROCESSES – THE POTENTIAL OF PARTICIPATORY METHODS

Maria Schwarz-Woelzl[1], Teresa Holocher-Ertl[1]

Abstract/Summary

The vision of the Go-myLife project (AAL-2009-2-089) is to overcome the risk of loneliness of older people by providing an online social network combined with mobile technologies customized to older peoples' needs. Eliciting requirements from older people who have limited experience with ICT usage regarding innovative products that do not yet exist is a challenging process. This article describes the participatory design approach that has been employed in the Go-myLife project aiming at the elicitation of end-user needs and requirements and it presents first lessons learned from this approach.

1. Introduction

In our increasingly dislocated and mobile society, online social networks provide a valuable means of bridging distances and facilitating interaction and communications, especially amongst younger people. However, older people tend to miss out on these benefits, as such technology is generally developed with young people in mind. Thus, the project Go-myLife aims to improve the social life for older people through the use of online social networks combined with mobile technologies. It aims to make it easy for older people to share reciprocal emotional and instrumental support, whether they are at home or out and about; with other words: it will provide a common place for older people to meet with their social network wherever they are and encourage them to get out of the house and maintain an active role in their community.

For further project information please visit the website http://gomylife.eu/.

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2. Methods – participatory approaches for the user needs and requirements elicitation

In order to develop an innovative mobile social network adapted to real user needs, in Go-myLife older people were involved in the project from the very beginning. In the first 15 months, seven end-user workshops were conducted, involving 23 participants aged between 55 and 75 in Austria and the UK. The workshops had two main research objectives:

1. Understanding the strengths and weaknesses of existing online social network platforms from an older person's perspective.
2. Analysing contemporary interaction patterns in social networks as such and the perceived desires of older people concerning communication support.

Therefore two different types of workshop were organized:

Workshop type 1: Assessment of the strengths and pitfalls of Facebook, plus four platforms popular with older people .

Each assessment was divided into four parts:

- The participants were invited for a "walkthrough" in existing social network platforms "thinking aloud", following specific tasks in pairs. Each pair received a set of materials, consisting of a "Scenario" and seven "Situation Cards" and "Situation Feedback Forms".
- After this session, each participant was asked to complete a standardized questionnaire about the frequency of their use of new media, the usability of the assessed social networks, and the added value derived from a particular social network.
- A short "storytelling walk" followed, giving the participants – again in pairs – an opportunity to share their experiences of modern communication media. The results supplement the findings from the questionnaires.
- At the end, a semi-structured discussion followed, where the participants talked about their experiences gained from the "walkthrough" exercise.

Workshop type 2: Exploration of older people's interaction patterns in their social networks.

The core exercise in the workshops was to explore the structure, involved social groups and communication patterns of the participants' social networks.

- The participants were asked to illustrate their social networks (artefact) and to present it to the workshop group.
- In a second round, they created a group vision about the ideal network in the future (ten years later) as the basis for an in-depth discussion. Group visions helped to deduce technical requirements for the Go-myLife platform.

A detailed description of the workshop methodology can be found in Deliverable 2.1 of the Go-myLife project. The results of the workshops are summarized in Deliverable 2.3. Both documents can be downloaded on the Go-myLife Website.

3. Results – why the workshops were successful

Eliciting requirements from older people who have limited experience with ICT usage regarding innovative products that do not yet exist is a challenging process. Older people may feel reluctant to talk about their personal problems (e.g. social isolation), and they do not have the experience with technology that would enable them to specify the technical functionalities that would help meet those needs. In tackling these challenges, we identified the following components for the successful implementation of our research methodology:

- *In order to create trust and remove fear of technology* we made the users aware of their role as "experts" in the design process. We created awareness that problems with technology can be in many cases attributed to poor product design and not to the poor knowledge of end-users. The fear of new technology was successfully eliminated by introducing the topic of new technology playfully via an adaption of the well-known game "Who Wants To Be A Millionaire?" Further, we used interactive presentation formats to keep attention and focus high.
- *In order to stimulate experiences with new technology* and to allow end-users to participate in fruitful discussions about new technology that they have not even experienced yet, we provided hands-on sessions (!) with technology to collect first experiences with new technology. During these sessions older people worked with practical scenarios, as well as photographs and videos, to increase imagination and tie the technology to practical concerns of the target group's everyday life.
- *It was important to alternate between different group sizes and question formats:* we worked with a balance of smaller groups to collect in-depth information and bigger groups to stimulate fruitful discussions. We used open as well as structured question formats.
- *We planned the elicitation carefully* as we collected sensitive information, like social isolation or loneliness, and considered in our planning which viewpoint users should take ("For me?", "For the group?" "For others?"). Crucial for avoiding psychological discomfort was the discussion about future fears rather than current problems. The employed methodology was tested previously in two explorative workshops.
- *Considering the knowledge and culture gap between end-users and researchers*, we assured the integration of the end-users' needs in the design process of the Go-myLife product by providing designers with artefacts, descriptions, testimonials etc. that illustrated the problems end-users had with new technology. For this illustration video-sequences and personas turned out to be useful instruments. The provision of training for designers to interact with older people appropriately was important for the successful transition of the needs and requirements elicitation outcomes.

4. Discussion

In the following paragraph further issues with regard to a successful end-user involvement are discussed:

The sandwich generation – the tension between family obligations and their right for time autonomy
For one of the seven workshops mentioned above, eight people had clearly given us the commitment to participate prior to the workshop. However, due to ad hoc family related obligations (e.g. illness of a grandchild, loss of the father etc.) only two of them showed up on the morning of the workshop and explained right at the beginning that they would not participate until the end of the workshop as they already had other plans (to see an exhibition, to visit friends on the countryside). From a researcher's perspective, this example highlights the challenges in organizing a sound sample size. From the older people's perspective, it shows that they are an important source of (spontaneous) support within their families, as well as experiencing the feeling of freedom – and probably for the first time in their life – to decide spontaneously how to spend their time.

Third and fourth agers together in one research setting – the challenges for the methodology
Research suggests fundamental social-psychological and physical differences between third and fourth agers (see D2.3 of the Go-myLife project) with different life perspectives and future visions. This is particularly the case when it comes to psychologically sensitive topics, such as "social embeddedness" and "future perspectives". Consequently, dealing with both groups in one research setting implies to have also an alternative methodology prepared which allows to be flexible according to the actual age profile of participants.

"Technology for older people" – a mismatch of end-users' and researchers' perception of the category "old age"
Participating in a project which deals with product development for "older people", implies that the end-users are considered as "old" from the researchers' perspective. However, the majority of our workshop participants were typical representatives of the so-called "Go-Goes", who are characterised by being still in good mental and physical health and still leading a busy and active social live (for categories of older people see D2.3 of the Go-myLife project). This discrepancy between older peoples' self-perception and the research assignment caused some psychological discomfort for both parties.

5. Conclusion

There were tasks that were perceived as challenging for the participants, which were due to the challenging nature of the topics themselves. The usage of online social networks is demanding for older people, due to usability issues, but also because of security/privacy concerns and different perceptions on how to communicate within older peoples' social networks. Further, we had to make participants think about possible changes concerning communication within their social networks with increasing age and how to address these challenges; this was a challenge as (older) people may be reluctant to talk about personal problems and the difficulty of thinking about future technological innovations.

However, we can conclude that the agenda of both workshops was useful for addressing the research questions and the methods used were adequate for the target group of older people.

The participants themselves found that the workshops were a source of personal enrichment, where they gained new experiences and took the opportunity for in-depth reflection about their social needs and future perspectives. In other words, they appreciated our interest in their actual life and were happy to share their opinions and experiences with the other participants.

EXPLORING METHODS FOR THE INCLUSION OF OLDER PERSONS IN ONLINE COMMUNITIES

Jonathan Bennett[1], Karen Torben-Nielsen[1], Sibylle Buff [2]

Abstract

Older persons (60+) are underrepresented in online communities. Given the potential social benefits that older people could gain from using such sites, the AAL project TAO Community & Collaboration investigates ways to bring older persons and online communities closer together. An evaluation of courses introducing older persons to online communities as well as results from an exploratory usability study of different online communities are presented. Findings show that although usability problems play an important role for older people, the relevance of an online community for one's everyday life is at least as important for predicting sustained participation. Following these findings, we provide practical recommendations for the setup of courses and the design of online community sites, which aim to increase the participation by older persons.

1. Introduction

How can we promote older persons' (60+) access to online communities? That is one of the main questions in the AAL research project TAO Community & Collaboration.[3] In formulating an answer to that question, we have two main goals. Firstly, we aim to develop effective methods to encourage older persons to actively join online communities. Secondly, we draw up recommendations to make the websites more accessible and usable for older persons –without losing sight of the needs of the wider community. The present paper offers first findings and recommendations based on the evaluation of a series of Internet courses from a Swiss online senior community, and an exploratory study of the usability of different online communities and the related behaviour of users between 60 and 70 of age. Older persons (aged 60 and above) are underrepresented both in online social communities and online collaborative projects [1, 2, 3]. Considering the increasingly important role and potential benefits of social media in most societies, this poses a serious challenge. On the one hand, we expect

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[3] This European research project (TAO 2010-2013) involves online community partners (Seniorweb in Switzerland and the Netherlands, Wikimedia in Switzerland and Germany), academic institutions and business partners from Switzerland, Germany and the Netherlands. TAO is the acronym for Third Age Online.

that older persons will benefit from the inclusion in online communities through an increase in social and human capital. On the other hand, given the growing proportion of older persons in many highly industrialized countries, online community sites are faced with the task of integrating older persons in order to remain functional in the long run.

2. Theoretical background

For the purpose of this paper, we will focus on one of many existing definitions of online communities;[4] an online community consists of persons with common interests, who use the Internet and other communication technologies for regular exchange, and/or to jointly develop content. They thereby develop strong mutual attachments and experience themselves as belonging together [4, p. 12; our translation]. Bishop [5] proposes that one of the motivating aspects for community members is the opportunity to engage with others in participatory or collaborative behaviours that are in line with important personal (e.g. social, creative) desires, plans, goals, values and beliefs. Furthermore, online communities are characterized by social exchange. Theories of social exchange usually explain the behaviour of an individual in terms of costs and benefits [6]. This means that a person will participate actively when he or she assumes a high probability of a personal benefit. However, if the costs of such active participation are considered too high, the activity will be limited.

It is important to note that the use of online technologies does not only differ according to age but also according to gender, physical challenges, marital status and level of education. In the case of older persons these different factors frequently interact, resulting in new disadvantages. This is one of the reasons why the age-dependent digital divide proves to be very resistant to change [7, p. 637].

Most barriers to using online communities are rooted in problems with sociability or usability [8]. While sociability refers to the social interactions of the online community, usability is concerned with the human-computer interface. Many older non-users cite fear of criminal activity, security risks, or obscene content as reasons for their non-use of the Internet [9]. Also, the Internet is often expected to be difficult to use and to have little practical benefit for older persons [10].

Moreover, non-users' social environment is often less encouraging of Internet use than the environments of users [11]. From the perspective of social psychology, participation in online communities can be seen as a behaviour that is to be established through social persuasion. Social persuasion thus must address relevant attitudes, cognitions, and behaviours [12]. Successful educational approaches therefore often use settings that allow for mutual assistance and peer-mentoring. Choosing locations that are familiar to older persons facilitates the linkage of technology with everyday experiences. Engaging older persons' existing social networks in the learning process and showing how the Internet and online communities relate to pre-existing topical

[4] For other efforts see [14, 15, 16, 17]

interests, have proved to be successful strategies as well [7]. Ideally, online communities should come across as personally useful, easy to use, and rewarding in the sense of providing the experience of self-efficacy [13].

3. Methods

This paper draws on two different types of investigation, which will subsequently be described in more detail. The first type is a series of Internet courses (*Free Cruise on the Internet*) organized by an online senior community, and aiming to introduce older persons (beginning Internet users) to different applications of the Internet including online communities. This approach was covered and evaluated using different observational and interviewing techniques. The second type of investigation is an exploratory study of the usability of different online communities, and of the motives and experiences of older persons (60–75 years) in dealing with these online communities.[5]

3.1 Courses introducing older persons to online communities

The series of Internet courses *(Free Cruise on the Internet*) was a campaign in the Swiss capital Bern to inform (60+) seniors about the possibilities of the Internet, and more particularly, about how they themselves could benefit from the Internet.[6] The activities took place in a local shopping mall that is much frequented by older persons. The campaign consisted of an information stand, which provided interested shoppers with computer and Internet information, and low-threshold Internet workshops and seminars offering hands-on Internet courses to seniors. The courses were created and taught by peer-group volunteers of an online senior community.

In order to learn more about how older persons could be encouraged to use the Internet more frequently and participate in online communities, we conducted a focus group and twelve standardized interviews with course instructors and assistants. In addition, 92 course participants filled in short questionnaires immediately after attending the course. Finally, ten telephone interviews were carried out with course participants circa one month after their course attendance.

[5] The authors would like to thank Swisscom, Zürcher Kantonalbank and Zeix AG for their generous support of this exploratory study.

[6] The campaign took place February–April 2011, and was supported by Bern University of Applied Sciences, telecom company Swisscom, wholesaler Coop, online community site Seniorweb.ch and the non-profit organization ProSenectute.

3.2 Exploratory usability study of different online communities

In a qualitative exploratory usability study, a total of eighteen participants (9 female, 9 male), aged 60 to 76 years were invited to usability tests, and were interviewed several times about their motives, experiences and future intentions concerning online communities. All participants had access to the Internet in their own homes and knew how to e-mail and use Google. As intended, the sample included both retired persons as well as persons still engaged in the labor market.

The main goals of the study were to recognize dominant obstacles to using online communities, to examine the kinds of social contacts participants desired on community sites and to recognize how online communities could increase their attractiveness to older persons.

Participants were recruited to form the following three groups, consisting of six persons each: (1) Active users: persons who were current users of an online community. Active users were either contributors to Wikipedia, or active members of seniorweb.ch or facebook.com. (2) Intenders: persons who were not active members of an online community but were interested in becoming an active member. (3) Hesitators: persons who could imagine – in principle – becoming involved in an online community, but who could not see how they would benefit from doing so.

Participants were treated to one or two test sessions, including an opening and closing semi-standardized interview. The main part of the test session consisted of participants' working through a "scenario" (a series of tasks) while being observed by two test administrators. Whereas the active users did the test with their usual community website, hesitators and intenders were asked to test two self-chosen online communities.[7] Active users went through only one test session, whereas intenders and hesitators were invited to a second test session four weeks after the first one. In addition, intenders and hesitators were questioned by telephone interview four weeks after their second test session.

4. Findings

4.1 Evaluation of courses introducing older persons to online communities

The enthusiasm and efforts of the volunteers, the low-threshold location in a shopping mall, the organization by and for seniors, and the coverage in the local press, contributed greatly to the success of these Internet courses. The course participants were mostly satisfied to the extent that they planned to participate again in a next edition of *Free Cruise on the Internet*, and/or recommend the classes to their acquaintances. The organizing team of (approximately twenty) volunteers considered the courses a success as well, and most of them quickly applied to continue their work for *Free Cruise on the Internet*.

[7] One of the chosen online community sites had to be Wikipedia, seniorweb.ch or facebook.com; they were free to choose a second online community.

Both the course participants and the volunteers made some remarks that are valuable for the next editions of *Free Cruise on the Internet*. Participants as well as volunteers argued that the recommended expertise level should be clearly communicated to the course participants beforehand so that every participant can choose the course that suits his/her situation. Although the course participants generally appreciated the way the course leaders addressed their questions, their overall satisfaction would probably increase if the course leaders paid extra attention to each participant's specific background and expectations. Furthermore, the telephone interviews with the participants (one month after the courses) demonstrated that most of them had not domesticated their new skills yet. Some participants were therefore interested in dedicated practice classes where they could freely practise the new skills, with a tutor on hand if needed.

4.2 Technological and non-technological obstacles to using online communities

The usability problems encountered in the exploratory usability study could, to a great extent, be traced back to a lack of user guidance and lack of explanations of functionalities. Too many actions that new community members were required to take demanded a mental representation – a cognitive schema – of what he or she was supposed to do. Many of the participants in this study did not yet have this kind of schema and therefore would have needed better guidance.

Fears of privacy breaches figured prominently among voiced concerns and many participants found the effort involved in contributing to online communities was too great in light of the potential benefits. In part, the reservations expressed by hesitators and intenders were nevertheless rooted in a too limited perception of the potential benefits of online communities. The actual benefits of online communities could in fact be much more diverse than was usually assumed by our study participants.

Efforts to motivate and integrate older persons into online communities must address existing counterarguments and stereotypes. A promising approach in this respect is through role models or positive examples. This approach requires a detailed definition of the target group so that persuasive messages can be tailored to fit them.

Interestingly, in their own reasoning, virtually none of the participants considered the described usability problems as being decisive for the future use or non-use of the community. Rather, participants exhibited a tendency towards hypothetical narratives (e.g. "Online communities are a good idea. But they just weren't made for me." or "Maybe later in life, when I won't be able to go outside anymore, I'll become a member of an online community."). Only in cases where there was an almost perfect match between the purpose of the online community and a participant's topical interests (e.g. travel writing) was there an authentic commitment to continued use and active contribution.

In terms of the preferred nature of social contacts there was a clear preference for engaging in online communication with persons one already knows.

5. Recommendations for the inclusion of older persons in online communities

In this paper, we investigated two approaches to bring older persons and online communities closer together. The first approach was via Internet courses, organized by and for seniors, which introduced their participants to online communities. The second approach consisted of an exploratory usability study, that sought to clarify the usability issues, motivations and barriers that discourage older persons from using online community sites. From these two complementing approaches to bridge the gap between older persons and online communities we distilled various recommendations, which are listed below.

5.1 Internet courses introducing older persons to online communities

- Distribute participants to different course formats depending on level of experience
- Apply “absolute minimum” theory (“I don’t need to know the history of the coffee machine in order to make coffee“)
- Avoid non-native languages and expert expressions
- Ensure quality of technical setup ahead of time
- Highlight easy entry paths for beginning contributors (e.g. chatting)
- Encourage help from “warm experts” (e.g. friends)
- Organize help from peers (same age/interests) in courses or learning groups

5.2 Setup of online communities that aim to attract older persons

- Make use of online collaboration (mentoring), adapted to seniors’ needs
- Make the human being behind the community member visible. Highlight “stories” of successful older community members.
- Link online community activities with everyday life and social interaction
- Don’t expect new users to know anything. Provide sufficient user guidance and explanations of functionalities.
- Make core community features highly visible.
- Make sure you know your target group. Provide content that is interesting to current and potential older users.
- Be clear about your community values. Participation is encouraged if potential members and the existing community share important values.
- Provide immediate reactions and feedback to new community members.
- Establish ways of certifying the trustworthiness of members (e.g. by indicating how long someone has been a member of the community, how regularly someone contributes etc.).
- Communicate the particular benefits for older persons of participating in this online community.
- Involve future users in the process of community development to ensure a satisfactory user experience.

Taking these recommendations into account should assist both organizers of Internet courses and administrators of community websites in encouraging older people to participate in online communities.

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UNDERSTANDING OLDER ADULTS' ATTITUDE TOWARDS ONLINE SOCIAL NETWORK: FOSTERING SOCIALIZATION THROUGH REMINISCENCE

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Abstract

The resistance of the older population to using and interacting with high-tech devices is due only partially to the lack of familiarity in dealing with the often unjustified complexity of such devices. Another important obstacle is represented by the lack of perception by older users of the relevance for them and the benefits they could get in using these new ICT-based solutions/services. In this paper we describe the approach adopted in the NoBits European Project that aims at bridging the gap between senior citizens and technology through the mediation of children and through the involvement of older adults in the interesting and intriguing experience of recalling their memories and transferring the heritage of the past to the new generations. A User-Centred Design approach, accordingly adapted to the specific target user group of the older population, was employed for the definition of the requirements of the system and the results of a first investigation on the acceptance of the project by the older adults are presented.

1. Introduction

In the technological world, older adults are still under-considered and seen as "non-technological" people; they are believed to be resistant to change and unwilling to interact with high-tech devices such as computers. However, the available data largely contradicts this stereotype and indicates that, like anyone else, elderly people accept and adopt technology when they recognize that it meets their needs and expectations. Indeed technology can play a major role in older people's lives, helping them to cope with age-related issues [1]. In particular, the internet and other communication technologies can enable older people to remain connected to family and friends and even increase their social networks through the participation in online communities. However there is a need to facilitate the access of the senior citizens to the new "digital world" and to match their expectations and communication styles: there is a

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risk of technology becoming an additional cause of social exclusion. Currently many websites are not readily accessible, poorly designed, use jargon and have difficult navigation strategies. The lack of relevance to older people of the web services causes their refusal to invest their cognitive, physical and economic resources in learning how to use the computer and the internet. Secondly, older people are worried by the effort of learning a new system and they are frightened by the absence of support. In this regard, Sourbati [2] highlights the concept of "assisted access to the Internet" i.e. the presence of someone close to the user who helps him/her in using the technology. From this point of view, the mediation of grandchildren and their engagement with their grandparents in a common, appealing "online experience" could represent an important reason fostering the interest of the older adults towards the new "digital world", since it gives them the opportunity of revitalizing their relationship with their grandchildren.

The NoBits Project started in May 2010, involving the population of an area in the northern part of Milano, the Castanese Territory, including eleven small villages. It aims at fostering social interaction between elderly persons and their families through the collection and sharing of memories, that is, reminiscences [3]. Particular attention has been given to the strengthening of social interaction between older adults and their descendants who are the primary consumers of technology and can provide support in digitizing the memories. The outcome of the NoBits Project will be a platform where tangible artifacts of an elderly person's life experience will be uploaded on a web site and become a significant resource to be used by other people and a means for connecting the elderly users with members of own and younger generations.

2. Methods

A literature review and a benchmarking about online social networks for older people were carried out first. Then, to get the opinion of the primary users, i.e. the senior citizens, we organized interviews and user forums. More than 100 older adults were involved overall, with an average age of 66 years. Even though this sample is small and characterized by a relatively young age, the collected data are useful for an initial understanding of this target group. All the activities were organized thanks to the support of the representatives of the aggregation centres.

In designing the "Reminiscence System" we adapted the User-Centered Design (UCD) approach to our specific target user group. UCD has been conceived for relatively homogeneous user groups; older people instead represent a group with a very high internal variability in terms of sensory, physical, and cognitive functionalities. In fact, considering people aged over 65 means to deal with a large range of specific generational differences that impact on attitudes, previous engagement with technology, health, finance and social issues. For these reasons the standard UCD methodology, seems to be less appropriate to older people groups and has to be modified towards a User Sensitive Inclusive Design methodology [4] that attempts to address some of the issues related with working with older people. We employed personas and scenarios for eliciting insights and opinions from the users (for an exhaustive description of scenarios and personas see [5, 6]).

3. Results

3.1 Older adults and ICT

As a preparatory stage we interviewed older adults in relation to their approach to communication technology (usage of mobile phones, computers, internet). The answers of participants clearly depicted a distinction between users and non-users. The non-users are reluctant to approach technology both because of little knowledge of it and because of fear of making a mistake and causing irreparable consequences. As regards the internet, the distinction between users and non-users becomes bigger: those who are familiar with internet use it for online banking, emailing, searching. Finally, with regard to a possible online exchange of memories, they reported that internet is a cold medium for this aim: *"Internet can help with video and images, but it is cold. Dialogue is a warmer and more direct way to share memories", "Facebook? Never, too much personal data!"*.

3.2 Older adults and the reminiscence

Reminiscence was investigated through interviews. The topics covered were mainly related to the meaning of "reminiscence", the benefits that older adults could have from reminiscing, the willingness of seniors to share their memories, and the way they prefer to collect them. The results confirm findings in the literature. Reminiscence has a great importance to older people and in particular is seen as a means for socialization. It seems to have a double function: it is a source of well-being for older people, and a source of learning for younger generations. Even if more often they share their memories with friends and family's members, they do not have problem talking about their memories with strangers. The important factor is having the possibility to decide with whom share the memories. In this regard they reported that they would prefer to talk with peers because they already share experiences and language that are not always guaranteed with the youngsters with whom misunderstanding is more likely. They all agree that the best way for sharing memories is by voice and talk about it, maybe helped by a picture or an object.

3.3 Insights for design

The preliminary design of the system was investigated by means of user forums. The advantage of a user forum is the possibility to reach many people and gather much information through self-filled questionnaires. On the other hand, in a user forum it is difficult to collect an answer from everyone. We employed user forums mainly to gather requirements and insights about the future online "Reminiscence System" that the project intends to develop. Each discussion was triggered by means of scenarios where personas were used as protagonists of the proposed stories.

It was indicated by the older participants that the best and most natural way to save and tell memories is oral speech, which allows one to tell a memory without having to care about style, mistakes and interruptions. Ease, naturalness and intuitiveness of use were attributes repeated several times during the discussion (few buttons, a different look from a typical computer, a system performing only the functionalities that it is supposed to do, use of the voice as input modality, small and light devices so that they can be moved and brought around, etc.). Another important aspect that emerged from the discussions was the preference for having a structured approach and for working in groups rather than on an individual basis ("*Working group with peers help to reason and to make a memory clear*"). The group is seen as a physical aggregation of people with similar interests (e.g. groups established at the senior aggregation centre) rather than a "virtual group" formed on the internet for "virtual socialization". Their preference towards group work seems to be related to their apprehension about using new technology. In this regard, the support of a peer expert or grandchild in using the computer was considered a suitable solution; furthermore the "grandchildren option" also provides the opportunity of enhancing the collaboration between generations.

4. Conclusions

Older people have ever been seen as people with no interest towards technology and reluctant to learn it. Nowadays that is no longer the case: the pervasiveness of technology in private and domestic life has become so high that older people have started to approach the technology in a different way, revealing more openness to it. An example is the mobile phone, once seen as a device for younger people and difficult to use, that is now also adopted by the older population, but for different reasons and motivations [7]. Nevertheless, older people have to tackle some barriers related both to technology and socio-economic factors. As Karahasanovic et al. [8] point out, the problems faced by older people with technology are less dependent on physical and cognitive factors, but particular emphasis has to be given to the perceived relevance of the technology in their daily life. Internet is an important tool for improving older people's quality of life by making them able to get in touch with their peers, with whom they may share knowledge, fears, and expectations, and experiences that they would not be able to do otherwise. Yet, the importance of providing people with devices that meet their needs and conform to their specific way of social and communication life is crucial. In conclusion, older adults are aware that learning how to use technology could be the bridge to strengthen the relationships with younger generations; hence we argue that levering reminiscence as a means for socialization and willingness to discover a lost relationship with the younger generation could provide older people with the right motivation to approach new systems.

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SOCIAL INTERACTION OF OLDER PERSONS IN 2035

Leonardo Martínez Suárez[1]

Abstract/Summary

In the past, older people not only held an important place in society, but they were also looked up to for their knowledge and experience. This model, however has changed to the point that not only do we prevent them from playing an active role in the population but there is also a false conception that they are a burden to society. Fortunately this point of view is changing and little by little we can see that the way we spend our money and leisure are changing. More and more older people are interested in ICTs, in technological advance and socio-cultural change.

1. Introduction

At the present time the longevity of the population is increasing. Old age can be seen as an opportunity to have time to do things which are seen as desirable and which one has never had time to do before. Thus, this stage of life can be seen as a liberation, in which the obligations are secondary and the main challenge is to take the opportunity to create or develop a vital project long overdue.

Innovation and research in these areas will enable a new model where people are not just more active and more emotionally satisfied. We also foresee the integration of older people in society, forming an active part in the organizational models. Not only retired and cease to be dedicated to leisure, but also as an active part of society, in terms of their attitudes and abilities.

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2. Methods

Physical Living Lab

- Development of physical and virtual prototypes to improve the quality of life of seniors considering the emotional design adapted to older people.
- Investigate the reasons for the gap that exists in the development of tailored products and the older person and define a solution.
- Development of leisure models for the "new" coming seniors. It might be understanding future seniors as a consumers of leisure and entertainment to create new tailored models to their tastes and needs.
- Testing and validation of products and services of external agents SeniorLAB partners.

Virtual Living Lab:

- We suggest the possible creation of a wi-fi network in "Los Santos de Maimona" giving access to a community of seniors. We will have a number of listed and registered users for possible validation of products and projects both inside and outside the consortium. This network will be a platform driver that can be exported to other populations.
- Creating a web platform accessible to all target audiences.

3. Results

As the main results we obtain knowledge about which services are going to be needed in the future, and those that exist today such as: health-related services, including home services. We especially take into account that the dependent elderly tend to live as much as possible at home and thus require much care and services for home maintenance, which may include home cleaning, services related to pets, and related services with new models of entertainment.

The social image of the elderly will gradually improve and this will continue in the future.

4. Discussion/conclusions

In conclusion, the elderly in the future will be more active, independent, capable, and not be constrained by the current technology gap.
We cannot predict the future, but we can establish the means to improve it.

TRACK C RATIONALE

Independence and Participation in the 'Self-Serve' Society[1]

The main goal of Track C "Independence & Participation in the AAL Call 3 - Self-Serve Society" is to enable a better cooperation and discussion between the Framework Programme (FP6/FP7) projects, the CIP projects and the nationally funded projects with the AAL JP project in order to highlight actual problems in the self-serve society and to ensure improved efficiency of the projects within Call 3.

A self-serve society is needed in Europe to reduce the cost associated with providing care as the population ages. This represents both benefits and challenges to citizens as well as care providers, both public and private. Goods and services across all areas of economic activity can be accessed and transactions completed by way of digital solutions. Opportunities for individual choice and personalization of products, services and the transaction itself to meet the demands and desires of consumers and citizens are becoming more common. In some areas the provision of such choice to citizens has been mandated, for example through legislation on accessibility. The trend is evident in commercial, cultural and public services but requires a positive approach in development from both suppliers and clients in order to realise the potential benefits of lower costs and greater flexibility.

Presentations from several active projects within the programs mentioned above, and four parallel discussion sessions will be held. Each session will focus on a specific topic (defined below) and will be joined by participants of the various Call 3 projects. The results of the active projects will be compared with the expected goals for Call 3 outlined in the keynote speech. A discussion on problems and challenges will be held – this will serve as advice and guidance for the newly initiated Call 3 projects.

Session C1 - Taking part in the self-serve society

The main focus of this session is on the socio-technological challenges of the self-serve society. Taking an active part in the self-serve society should be encouraged for as long as possible for all population as they age or should they become unwell. Support is needed since the ICT-based self-serve society presents problems, in particular for older people with physical or cognitive impairments or little or no familiarity with technologies. Solutions which increase independence and efficiency for experienced technology users may inadvertently threaten others with exclusion and

[1] AAL Forum 2011, OnSite Guide and Programme

loss of independence. Therefore, there is an emerging need to stimulate and support the capacities required for more inclusive or pervasive participation (e.g. mobility, physical, and cognitive). This session will give an overview of the topic but will also point out the difficulties and problems actual projects have encountered.

Questions for this session to answer are:

- Definition of the domain
- Goal of call 3
- Are elderly people engaging with the solutions being developed?
- How the technological barriers be overcome?
- How can the solutions be improved to provide more trust?
- What are the next essential steps and what are the trends?

Session C2 – User interfaces and User interaction

Whilst it is expected that existing and evolving solutions and services can provide robust and reliable support to users, the work carried out under the active research programmes has shown that an emphasis should be placed on the development of better interfaces (screens, handsets etc) that are able to meet the needs of a wide range of elderly users, including those who are not presently familiar with ICT-based technology. The services that elderly people actually want to use need to be readily and clearly accessible via interfaces that can be easily integrated into their lifestyles. On the other hand, services not used as interfaces could be perceived by users as off-putting, time consuming or of limited benefit. User-orientated intuitive interfaces therefore may help to overcome the acceptance barrier to the use of AAL applications and services that enhance the joy of life and fun. Increasing the autonomy and independence of the elderly through supporting their participation in the self-serve society is the goal for Call 3.

Questions for this session to answer are:

- What are the trends for user interfaces depending on age?
- Which aspects have not been addressed to date?
- Which technology is most appropriate for the elderly: AR, avatars, digital butler, speech, gesture (from the gerontophysiological point of view)
- Which interfaces are not working well?

Session C3 - Self-services in daily living

The main goal of the session 'Self-services in daily living' is to enable support and its customization to meet individual needs for the whole service chain comprising different providers, channels, methods and market segments. This session focuses on the integration of new ICT-based solutions available from existing service providers, channels or market segments that can be adapted to meet the seniors' needs. A very important aspect here is the ease of use of services. There is also an urgent need that services have to be made easily accessible by the elderly.

Questions for this session to answer are:

- How to make services more humane, since in many cases there is no contact with human beings?
- How to personalize the services (e.g. automatically adaptation to preferences, needs and health conditions)?
- What are good / bad examples for self-service?
- How we can ensure that people can use a service?
- Is the whole spectrum of the service and support chain covered?

Session C4 - Speakers Corner

This session will be organised around presentation of posters, one-two minute presentation and the discussion.

Session C5 – Panel Discussion

The C5 session moderators will first gather key issues addressed in the preceding four sessions related to end user perspective, ethical issues, business perspectives and the technological solutions of the Call 3 projects. In this session, a discussion panel involving four invited speakers from the different subject areas will be organised to further discuss the identified issues and to try to address the following questions:

- Do we really want to have a fully automated self-served society?
- What influences will the technology deployed have on the users?
- Which services are available, which are missing?
- What are the needs for the self-serve society in this domain?
- What kind of knowledge is necessary to use the services?
- What good experiences and examples of problems encountered are there?

The goal of the session is to enable a deeper discussion between the different stakeholders and the Call 3 projects.

TRACK C NOTES

SESSION C1: TAKING PART IN THE SELF-SERVE SOCIETY

Andreas Braun[1]

1. Session Rationale

The main focus of this session is on the socio-technological challenges of the self-serve society. Taking an active part in the self-serve society should be encouraged for as long as possible for all the population as they age or become unwell. Support is needed since the ICT-based self-serve society presents problems, especially for older people with physical or cognitive impairments or little or no familiarity with technologies. Solutions which increase independence and efficiency for experienced users of technology may inadvertently threaten others with exclusion and loss of independence. Therefore, there is an emerging need to stimulate and support the capacities required for more inclusive or pervasive participation (e.g. mobility, physical, and cognitive). This session will give an overview of the topic but will also point out the difficulties and problems actual projects have encountered. The session was planned to answer the following questions:

- Definition of the domain
- Goal of Call 3
- Are elderly people engaging with the solutions being developed?
- How can the technological barriers be overcome?
- How can the solutions be improved to provide more trust?
- What are the next essential steps and what are the trends?

The first session of the AAL Forum Track C, Independence and participation in the self-serve society, had the topical focus ‘Taking part in the self-serve society’. It was held on 26 September 2011 in the Carvaggio room of the Tiziano conference hotel in Lecce, Italy, and ran from 15:14 until 16:41. The session chair was Reiner Wichert.

2. Session Contributions

The first talk of this session was the keynote address, ‘Serving the self-servers – Making the self-service society a reality’, presented by Joe Gorman and Juan Pablo Lazaro-Ramos. They presented key factors that prevent more widespread adoption of AAL services in actual applications. These are; sceptical end-users, the lack of a lobby

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supporting AAL services, a still missing robust technological platform, and excessive focus on research instead of products. A potential solution was presented in an approach that combines an easy-to-use marketplace for AAL solutions, a stable AAL platform built upon the best practices generated in previous efforts, and the creation of a sustainable community of AAL end-users, researchers, industrial partners and open-source developers. This approach is the foundation of both the AAL open alliance and the European research project 'universAAL'.

The second talk of this session was titled 'Project AUTAGEF – Business Model and Use Case'. Jana Clement presented the initial results of the AUTAGEF (automated assistance in health critical situations) project. She presented the approach of bringing AAL and potential users together, bridging issues like the prevalent fear of technology, stigmatization of users and, most importantly, the initial cost. The system is based on smart meter technology and focuses on energy savings. A key idea is to separate research and end-users by mediating all communication through a housing corporation. Questions arose about the marketing of such a product – whether it would be directly sold by companies or through the housing corporations. The latter option was considered more feasible.

The third talk, titled 'Gateway to the world from the living room – Smart Homes', was presented by Claire Huijnen and presented Smart Home, a research approach associated with the SOPRANO project that applies user-centred design and acceptance testing in fifty-five real-environment test homes. The approach is sophisticated and includes technologies like touch-screen controls, video communication and user-based access control systems. Those services were evaluated for user acceptance, resulting in high acceptance rates, and the importance of social factors in system design was observed, most notably a sense of community in terms of neighbours providing each other with help that strongly encouraged system usage. After the presentation, questions were posed regarding users' tendency to answer positively because they were offered the systems for free. It was acknowledged that this effect does exist and that the use of a monitoring system gives better results than questionnaires. Finally technical personnel were encouraged to integrate users strongly in the design process, even in the early stages.

The final talk of this session was 'Tablets helping elderly and disabled people'. José Luis Pajares presented different projects that provide tablet applications for older adult users. APEINTA is a project for deaf and/or mute persons that uses a cloud-based service to connect teachers and students. It supports on-the-fly subtitling from spoken messages. GVAM extends this approach to museums using touch-screen devices that are able to display sign-language videos and rich-media content management in the background to support visitors individually. The last project presented was UC3MTitling, a software tool that supports videos of events with subtitles, sign language and audio descriptions, partially in real time.

SESSION C2: USER INTERFACES AND USER INTERACTION

Paolo Raspa[1], Francesco Ferracuti[1]

1. Session Rationale

Among the AAL JP Call 3 objectives, enabling elements promoting the general inclusion of elderly people in the information society, such as user interfaces, are considered. A result of active research projects currently carried out under the AAL JP Call 3 is that an emphasis should be placed on the development of better interfaces (screens, handsets etc.) to meet the needs of a wide range of elderly users, including those who are not presently familiar with ICT-based technology.

Therefore, this session of the C track is focused on projects assessing interaction with a special focus on readability, usability and integration into elderly people's lifestyles. On the other hand, services not used as interfaces could be perceived by users as off-putting, time consuming or of limited benefit. User-orientated intuitive interfaces, therefore, may help to overcome the barriers to acceptance of the use of AAL applications and services that enhance the joy of life and fun. Increasing the autonomy and independence of the elderly through supporting their participation in the self-serve society is in fact a goal for Call 3. End-users should be actively involved in the work to be performed with appropriate methodology applied (e.g. user-centred design). Effective solutions should be flexible and adaptable to the end-users' needs throughout the phases of ageing.

2. Session Contributions

This session, chaired by Dr.-Ing. Reiner Wichert of the Fraunhofer IGD Institute, comprised projects concerned with developing and assessing user interfaces and user interaction by means of AAL technologies. The session provides insights into the kind of experiences the elderly have with the interfaces for services for the self-serve society.

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2.1 Virtual Reality and Augmented Reality tools for designing new highly usable human-systems interfaces, Ceccacci et al.

This research, developed within a nationally funded e-kitchen project in Italy, considers how Virtual Reality (VR) and Augmented Reality (AR) technologies, allowing simulation of the behaviour of the user that interacts with a virtual representation of a product or environment, can be used for designing a domestic environment in order to evaluate and improve the usability of the system in the early design stages.

The goal of this research is to assess whether Tangible Augmented Reality (TAR) technology can be used in order to involve the elderly in evaluation of user interface usability. For this purpose a traditional high fidelity prototype and TAR interaction are compared.

An AR environment was set up, using 3D printing and a marker-based optical tracking system. The augmented prototype is visualized through a head-mounted display. It was pointed out that satisfaction in use does not vary with respect to traditional high fidelity prototypes.

Until now no studies have been conducted to assess the optimum VR technology for the involvement of elderly people in the evaluation of design solutions. Preliminary results obtained show that TAR technology could be a valid alternative to traditional methods for the evaluation of product interface usability and that the interaction with the virtual interface does not invalidate the usability evaluation itself.

The outcomes of the discussion were that the target group of this work is elderly people without impairments. Considering how the lack of particular skills can impact on the performance of each task performed in the kitchen, virtual environments could help to define the characteristics of a clear set of appropriate facilitators to be provided in order to design a barrier-free concept.

It was also mentioned that the Bali project, which ended in summer 2011, in Spain is similar to the Italian e-kitchen project, and final results and data are available, therefore comparisons between the two projects could be made.

2.2 Gesture recognition interface using a bio-inspired optical sensor, Zima, et al.

This research work, developed within the AAL-JP project FoSIBLE (Fostering Social Interaction for a Better Life of the Elderly), aims to provide a simple to use user interface for the elderly, based on an optical stereo-motion sensor and a gesture recognition software module, which can be used for interaction with television sets and social media platforms. The paper presents an overview of the system and the preliminary results of the gesture extraction.

The UCOS2 3D motion-sensing device, developed in a previous project, is based on a biologically-inspired “Silicon Retina” optical stereo sensor. Unlike other 3D sensing devices and camera-based technologies, the device is sensitive only to changes in light intensity, e.g. caused by the user’s movements, and does not track scenes, therefore it does not involve the ethical issues that affect systems using cameras in the home, and therefore it could be more acceptable for the end user. Future work will include a comparison with the Kinect device, and the audience was interested in the differences.

In the discussion, it was added that the sensor’s spatial resolution (128 x 128 pixels) is too low for recognition of complex movements like finger recognition, because it is not clear which finger is actually moving.

2.3 Touch generation: one-handed single- and multi-touch menus for the elderly, Wimmer et al.

This project presents an evaluation of the usability and accessibility of the touch-screen interfaces of mobile devices when used by the elderly. Tests were conducted to determine age differences when using one-handed single- and multi-touch menu types to be operated with different finger orders.

Tests were conducted on thirty-two users, sixteen young people with a mean age of 24.63 years (standard deviation of 2.19 years) and sixteen elderly people with a mean age of 67.75 (standard deviation of 4.57 years), without impairments. Additional tests were conducted using five different menu types using a smartphone to be operated with different finger orders, using both single- and multi-touch interfaces. End users were involved in the training phase and in the evaluation. No studies have yet been conducted to assess age differences when using one-handed single- and multi-touch menu types to be operated with different finger orders.

The results were compared age differences between the two groups, considering performance, accuracy in terms of error rate and type. Young users were significantly faster than older users, whatever the interaction type. The reason is that they are well technology enabled. Both younger people and the elderly benefit most from single-touch interaction, operated with thumb/index finger order. The reason is that for single-touch interaction, people do not have to concentrate too much. Moreover, elderly people’s fingers are not as flexible as those of younger people, therefore they are not well suited for multi-touch interactions.

2.4 Mobile contextual assistance for barrier free mobility of elderly people in public transportation, Paletta et al.

This project is developing mobile assistance for barrier-free navigation in urban public transportation, targeted at elderly people. The goal of this research, which is part of the project MARIA, is developed as a specific application service for today’s smartphones and continuously assists the elderly passenger on his or her way.

The basis for this technology is mobile phones that are already available on the market, with graphical displays, a camera and innovative image analysis methods. The scenario is to direct the mobile camera to a public transportation sign (bus stop) or a textual region (at the bus stop or within the train) and to receive audiovisual information for assistance, for example, by text-to-speech or easily understandable graphical instructions. MARIA includes an intuitive assistance for barrier-free use of public transportation. Images of signs or text are analysed, the context associated and the system may start appropriate assistive behaviour to support the user. This technology also uses the multi-sensor equipment of mobile phones for position and acceleration sensing, digital compass and GPS receivers.

MARIA involves a user-centred design strategy with direct involvement of the user in order to attain universal accessibility, usability and user experience. The goal of MARIA is to develop a continuous service for assistance which is a major concern for support of the perception of the environment and the mobility of elderly people. Focus groups have been investigated together with specific user groups to develop scenarios for the use of the MARIA functionalities. The MARIA mobile service assistance technology is not yet applied to already existing mobile services on public transportation in real contexts.

In the discussion it was added that the collected information is not used for improving the transportation infrastructure and for private car journeys at the moment, but these could be addressed in the next project.

2.5 Dietary nutrition assistant with multimodal interfaces and Functionality Intelligent Kitchen-Terminal, Scheitz et al.

The objective of the DIAFIT project is to develop an innovative multimodal assistant for the nutrition of elderly people in order to evaluate their nutritional behaviour and to support them individually. DIAFIT essentially consists of a terminal that provides the user with direct and natural access to communicate with the nutrition assistant. An interactive touch screen allows the entry of the actual situation with graphical, intuitive icons and visual communication with the assistance avatar. The multi sensor input system enables a user-friendly food input with image-based object detection and bar code recognition; quantities are determined by a synchronized digital scale.
The target group (aged 60+) was fully involved in the specification, design and finally evaluation processes.

The central component in the ‘intelligent kitchen for senior citizens’ is an innovative IT-based interface for intuitive input, which is used in cooking foods in certain quantities. The ‘Recommendation’ service is a highly innovative component of the user interface with great future potential. The intelligence of this system component will decide – in coordination with the individual’s dietary habits and the short-, medium- and long-term nutritional status, and the responsiveness of the user – on time, type and scaling (food, recipe) the recommendations for the regulation of a healthy diet. The DIAFT system is a multi-user system. A user can log on to access his or her own diet and nutritional plan.

In discussion it was mentioned that the target group, aged 60+, is too young; they do not need assistive technologies, the focus should be on the 85+ age group who really need this system, but if 60+ people start using this technology now, they will be more prepared to use it in the future .

3. Conclusions

This session, chaired by Reiner Wichert, Fraunhofer IGD, presented user interfaces like VR, cameras, smartphones and touch screens, to enhance elderly people's well-being and social interaction. These are now well-defined, standardized, widespread technologies and already widely used by most people, not only by young people but also by the elderly. In the projects reported in the third and fourth presentations, the elderly are fully involved during specification, design and finally evaluation of the works, while in the others they are just involved as testers.

The results of the projects reported in this session are remarkable and they can be recommended for use by the elderly. However, the target groups for all the projects in testing were people aged 60 to 70, and age differences among people in the target groups are small. It was pointed out by one scientist in the audience that people aged below 70 do not need assistive technologies and the focus should be on the 85+ age group who really need these systems, but if 60+ people start using these technologies now, they will be more prepared in the future to use them. Moreover it was pointed out by the audience that no tests had been designed to assess accessibility and usability for people affected by some impairment.

The presentations showed that there are collaborations between the projects, the Centre for Usability Research & Engineering (CURE) in Vienna, responsible for the third project presented, collaborated with the Austrian Institute of Technology (AIT) for the User GUI menu navigation concept in the second project and cooperated with the MARIA and DIAFIT AAL-JP projects, which are closely linked to each other.

Even though the discussion showed that the projects presented only preliminary results, they are promising for the assessment of elderly users' interactions with AAL technologies.

SESSION C3: SELF-SERVICE IN DAILY LIVING

Andreas Braun[1], Sten Hanke[2]

1. Session Rationale

The main goal of the session 'Self service in daily living' is to enable support and its customization to meet individual needs for the whole service chain comprising different providers, channels, methods and market segments. This session focuses on the integration of new ICT-based solutions available from existing service providers, channels or market segments that can be adapted to meet the needs of elderly people. A very important aspect here is the ease of use of services. There is also an urgent need for services to be made easily accessible by the elderly. Questions for this session to answer were:

- How to make services more humane, since in many cases there is no contact with human beings?
- How to personalize the services (e.g. automatic adaptation to preferences, needs and health conditions)?
- What are good / bad examples of self-service?
- How we can ensure that people can use a service?
- Is the whole spectrum of the service and support chain covered?

The third session of the AAL Forum Track C, Independence and participation in the self-serve society, had the topical focus 'Self-service in daily living'. It was held on 27 September 2011 in the Carvaggio room of the Tiziano conference hotel in Lecce, Italy, and from 14:30 until 16:00. The session chair was Claus Nielsen.

2. Session Contributions

The first talk by Felippe Mirales was titled 'Secure and active aging: Project about participation and health for older people' and presented results of the SAAPHO[3] project that focuses on including AI approaches into typical AAL applications. Bayesian classifiers are used to infer behavioural patterns from various context data – in this case time, environment and services. Questions arose as to the target group of such services. The system has been successfully tested with different age groups and

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[3] http://www.saapho-aal.eu/

the general approach will allow application to various target groups. The system is intended for both public and private sale with partners yet to be found.

The second presentation, by Immaculada Luengo, introduced the WayFiS project[4] that is helps older adults by providing phone-based support for public transportation and path finding by foot. Individual limitations of users are taken into account, as well as pre-entered information about the accessibility of public locations. The system will be tested for single and multi-user applications with up to 80 users. Questions arose about the sustainability of the service as soon as the phone fails, and the answer was that as a web-based solution it can be used by various devices. The application will be available for free but users will have to pay for extended services.

The next presentation was on the CASALA[5] research initiative and was presented by Julie Doyle. The focus of the talk was on the CASALA living lab, comprised of sixteen single apartments in one facility that are equipped with several hundred sensors. This living lab is generating a huge data set that is of interest foremost to the inhabitants of those apartments who can view their own data, but also to researchers who are able to infer behavioural information from this set. The users are given tablet devices that allow them to control their environment. The approach is user-centred, trying to include participants from the very beginning. Questions arose as to the ethical aspects of such large-scale monitoring and it was concluded that the best solution is to give users access to the data, how the data will be used and what potential innovations might arise from that. Currently the data is not used for emergency applications and the users can select what data they want to have collected.

Afterwards there was a presentation about NETCARITY[6] by Ilse Bierhoff. This project is using a service-centric as well as a user-centred design approach. The whole service life cycle has to be considered and the users have to be included in the design of services. In this case potential users designed the system and interface with paper mock-ups and it was later implemented. The result is an easy-to-use touch-based UI using real-life metaphors for simplification. A following question was about the process of having older adults as designers and if they knew what they wanted. It was agreed that this is an experimental approach that was difficult at the start but led to many aspects that were included in the final system. The business model envisions a mixed buying scheme of public sector and individual purchases.

The final talk was by Emanuela Merelli who presented ACTIVAge[7], a project in the scope of the i-Live cluster in the Marche region of Italy. The project is providing self-adaptive services for older adult users based on a multi-layer software architecture supporting the adaptability of services when the requirements, e.g. health of the user, change. These requirements can be monitored via sensors and mapped to a virtual

[4] http://www.wayfis.eu/

[5] http://www.casala.ie/

[6] http://www.netcarity.org

[7] http://cosy.cs.unicam.it/AAL

representation. A question arose regarding the use of avatars in this project, where it was mentioned that these are able to aid in prediction tasks, e.g. in fall detection.

Session C3 concluded with an open discussion focusing on the multitude of similar services that are being developed in the AAL community right now and how the knowledge can be reused. Everyone agreed that this was an open question and that using interoperable standards and open-source solutions might lead to a more widespread adoption of AAL. The chair urged all participants to support open initiatives like AALOA and universAAL, as well as increasing collaborations to create products and services that are truly interoperable.

SESSION C4: SPEAKERS' CORNER

DI, GuoQing Yin[1]

1. Session Rationale

This session was chaired by Ad van Berlo from Smart Homes and was organized around nineteen presentations of posters, with each two-minute presentation time followed by a discussion.

2. Session Contributions

The 'Happy Ageing' project team focused on the acceptance of technologies of AAL. They argue that it requires a deeper knowledge of older people's characteristics, living environments, social relationships and needs, meaning a deeper knowledge of the heterogeneous elderly population. In turn, this leads to the diffusion and exploitation of the systems, supporting new markets such as gerontechnology, and discovering new segments of consumers.

The team from Jade Hochschule introduced a fall detection application using smart phones with the Android operating system. The system can identify a critical situation and autonomously generate alarm calls (including current position and help text as SMS or TTS message).

The 'My Life' project introduced a tablet device for primary end-users' time orientation, communication and recreations activities, and furthermore illustrated a secondary end-user's web for configuration and content management. Ten principles for accessibility design of the primary end-user's interface were introduced too.

The 'Smart Companion' project introduced a mobile companion for older adults. The project aims to supply a companion permanently available to support seniors in their daily activities. Currently it enables the user easily to unlock the phone, call relatives and friends, send voice and text messages, manage contacts, call the emergency line, launch applications, and listen to music and radio.

The goal of the 'Auditory Valley' project is to integrate and extend technologies primarily developed in the field of hearing aids into conventional and widely used communication and entertainment devices. The targets and orientations are

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personalized hearing systems, audio system technology and assistive systems, and communication environments. The technologies used are automatic speech recognition, user interfaces for older persons, beam forming and position estimation, and reminder function.

Enabling self-service in everyday living: a feeding and kitchen activities project was introduced. The project focuses on the safety and life quality of the user. The idea is to use smart, networked appliances, environmental and personal monitoring, multi-modal user interaction and internet services.

The goal of the ‘Senior Channel’ project is the development of an interactive digital television channel to provide elderly people with an opportunity to interact with the wider community, a means of access to diverse activities including: sharing knowledge and experience, topical debates, entertainment services and discussion groups. The user technologies are an integrated virtual studio and production centre to produce television programmes in the senior centres: low cost, 3D graphics and virtual studio scene. The media centre is specifically assembled for the project, based on Linux. The user interface is highly intuitive interactive services, based on an easy-to-use remote control.

The NETCARITY project introduced a hardware/software framework for poster recognition in AAL applications. The applications are critical event detection (e.g. falls), analysis of ADLs, homecare monitoring, rehabilitation monitoring, and nature HCI. Two feature extraction approaches were introduced: volumetric to spatial distributions, and topological to body skeleton. The evaluation is over distances. Complementary performances: details vs. speed.

The “Homage for Life” project a personalized self-service platform for the ageing-in-place was introduced. Homage for Life combines the five critical success factors that need to be addressed: establishment of a proven, mature ICT and internet infrastructure; identification, analysis and prioritization of the needs/aspirations of those aged 70+; commitment to participation by members of the 70+ group; availability of a persistent, ongoing, self-service operation infrastructure (24/7); and a commitment from significant multi-stakeholders service suppliers.

The “SPES” project has the following characteristics: based on the OLDES platform and extending to (i) respiratory problems, (ii) dementia, (iii) handicapped people, (iv) social inclusion. It has 100 clients in two pilots (in Bologna and Prague). User-centred design is crucial. The technology involves remote control and touch screen.

The “PCS” project introduced a personal protection and caring system. The system combines services and functions such as: web 2.0 service platform, call-centre contact, innovation, watch-like device; location-based emergency aid, location-based information; sensor functionalities (e.g. fall detection); voice communication; geo-/cardiac tracking of sport activities.

The "i-Live" project focuses on the research and development of ambient intelligence technologies for independent living to improve the quality of life. The actors are networking to build a cooperative attitude between different actors involved in the innovation process. The project will develop a strategic frame of several private and public initiatives for economic development towards a smart specialization of traditional productive clusters.

An ambient activity system was introduced by AAS platform for streaming the AAL services project. The system characters are individualized, declarative and open.

The "Capmouse" project introduced a truly hands-free human interface. The device has the following advantages: external, comfortable and non-invasive; lightweight; not system dependent but compatible with all major software platforms using a standard USB connection; easy to start using due to auto-calibration and firmware embedded in the device.

The "health@home" project focuses on lessons learnt and a future perspective in the home monitoring of patients affected by chronic heart failure. The telemonitoring system includes: data acquisition from wireless sensors, data analysis to detect alarm situations, data transmission to remote server (HIS), configurable operating protocol (OP), graphical reminder function, measures drugs, and possibility to submit perceived symptoms. The advantages of remote (home) monitoring are reducing response time in case of necessity, reducing hospitalization, reducing costs, improving the patient's quality of life.

SESSION C5: PANEL DISCUSSION

Sten Hanke[1], Juan-Carlos Naranjo[2]

Praminda Caled-Solly, University of the West of England
Giulio Antonini, Friuli Venezia Giulia Region, Italy
Tatiana M. Burkov, Telemed, Norway
Claus F. Nielsen, DELTA, Denmark
Birgid Eberhardt, VDE, Germany
Sergio Guillen, ITACA - Universidad Politécnica de Valencia, Spain

In the panel discussion of the sessions on independence and participation in the 'self-serve' society the different session moderators had gathered the key issues addressed in their sessions related to end-user perspective, ethical issues, business perspectives and the technological solutions of the Call 3 projects. To summarize the outcome, the following related questions were addressed:

- How we can improve the AAL solutions in the self-serve context to provide more trust?
- How we can overcome the barrier of technology for elderly people?
- How can we make services more humane since in most cases there is no contact with human beings?
- How can we manage it so that people can use a service? How can we make it available and appreciated by them?

1. How we can improve the AAL solutions in the self-serve context to provide more trust?

Improving AAL solutions in a self-serve society and to provide solutions where the end user can trust the transparency of data has been mentioned in the first point above. Although we may try to hide the complexity of the technical solution the primary end users need to know the underlying process and how things happen to engender trust in the solution.

What we need is also trusted devices, which are easy and simple to use via plug-and-play. As an example of this, the Continua Health Alliance has been mentioned. This is a non-profit alliance which already has more than 240 members with a great interest in establishing an ecosystem of health, wellness and AAL with devices the user can trust

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in the sense of interoperability and therefore a joint usability. So far the focus of Continua seems to be in the field of chronic disease. What will come out of it for the AAL market remains to be seen. Anyway in all cases the usage and interaction and the transfer of the data between devices must be secure. It should not be the task of the user to care about a safe Bluetooth pairing of different devices. We need devices which we get and with somebody providing us with the assurance that they are safe, secure and private. We need to trust them with an inner conviction.

Of course it is always difficult to trust in technology. It is always related to other "kinds" of trust. It is related to trusting in the people who provide or develop the solutions. It can help when the people providing the service are also trusted to give advice on how to use it, if they take the time to explain, not just to provide the service or the technology. Maybe you can start to trust when people start to care and start to search for a solution. Another motivation that can help to establish trust in services and solutions is word-of-mouth. It convinces others faster if, for example, their friend is using the device already and assures them that they can trust it. This is the potential of well running solutions and services – that they can spread confidence in something new.

2. How we can overcome the barrier of technology for elderly people?

The biggest technological barriers for elderly people are robots used as assisted technology. Of course robots are quite new and the technology of robots is complex. There are often large barriers for AAL technology and it is important that we understand these different barriers. There are physical barriers of technology, especially for robot technology. There are barriers with non-adaptable technology. This is an age-related condition. Many problems for the end users come with time. So technology should be able to adapt to these problems and create the ability to solve problems over time. We also have conceptual barriers. How to guarantee trust in and transparency of processes and data? How we can provide solutions and make things work? What are the steps needed to make it work? Cultural barriers can play a role. Is the solution or technology able to be transferred to different cultures? What is the relationship of the carers to family members? Who has which information about the process etc.? A large barrier can also be economic. Elderly people often have problems paying for their daily living expenses (like electricity etc.). Can they be expected to afford most of the AAL solutions? We should also consider this when planning. Which can be the technical solution that fits in the given surroundings and people's homes? Often thinks are designed for an ideal case, such as for large-scale homes. This applies especially for robotics.

Social barriers are also important. Assisted technology is often seen as a social stigma. The elderly might not want their friends to see certain assisted technology devices when they come over. There must be a balance between devices and solutions for personal care that are private and those which the elderly person has to wear and carry around. Finally, the gender aspect plays a role. Elderly women and men often respond and behave differently. Willingness and fear are examples of such differences.

Another major barrier in the field of AAL solutions is the process of how to get the end user to use the new technology and devices. It is important that students and care givers are already open to innovation and starting to know and learn about new technologies. A problem which has to be solved in the next few years to overcome this barrier is the integration of the knowledge in the education process for applied gerontologists and mechanics, among others. Nowadays the education about AAL systems and technologies is not very integrated in qualification and teaching. Germany. for example, has already started with this education process for many stakeholders in the AAL network by establishing domain focused certifications.

Another barrier is of course that a lot of AAL products and solutions hide existing standards by not integrating them. Especially when we consider the regulations on medical devices this is a problem, for example, for emergency systems. There certain regulations have to be fulfilled to guarantee safety and this is also an insurance issue. So even if the end user wants to buy solutions it may be difficult to find solutions that fulfil the existing norms and regulations. Without the integration of the existing norms there will be no broader usage of the products as they are too risky for many official institutions (hospital, care organizations etc.).

A chance to overcome this problem or to impose a common solution can be seen at the AAL platform projects like universAAL or Persona, which provide the possibility to hide these standards for the end user and provide a streamlined process of standardized integration. In this way, for the end user, a kind of trust through branding can be established as well. Anyway at the moment the point of even low level standardization is not very much in the mind of most of the AAL stakeholders. This makes it even more difficult to impose high level standards for e.g. horizontal solutions.

Overall it can be said that human contact is of course an important matter and technology should not be introduced to replace this. Therefore there are always different views on different types of technical solutions. Anyway, based on surveys in Denmark, we can say that elderly people would use more technology than at present and also technology which is not implicitly used for care but also entertainment etc.

3. How can we make services more humane since in most cases there is no contact with human beings?

To make services more human it is important that services are provided by the local region and involve the different local stakeholders which can support the quality of life at home. But what is quality of life? What does it mean and who is responsible for it? Is quality of life a health care issue? Yes, it is basically a social health issue. So there are many involved stakeholders who share the responsibilities.

But when we speak of human services at home, the home itself plays an important role. Nowadays how many architects are involved in the process of planning ICT for the elderly or generally, ICT in homes? How many house planners and interior architects know about the opportunities of ICT in homes? And moreover, how many municipalities are aware of the ICT AAL opportunities? Are there big differences between urban and rural municipalities?

In response to these questions, it is recognized that urban populations have a better acceptance of AAL solutions while rural dwellers have other priorities, like physical accessibility of basic services. A good example of these things working together is the Trieste area. There ICT AAL services are very well accepted by the elderly end users. In contrast, in the mountain area around Trieste (80 km away from the city) nobody wants ICT services because there are problems with the certain roles of stakeholders and the weak integration in the houses etc. Quality of life is a patchwork of many things and services, it involves the house itself (the ICT integration planning, the house adaptation etc.), care services fragmented into public services, private services, informal care etc. – the burden of managing all these things is always on the family's shoulders. All in all, only 5% of Italians receive services at home in Italy. What helps to make services more human is the support of associations of family members which also include younger persons and encourage them to stay at home in shared communities. As a negative example, an exhibition in Trieste in 2010, where quality of life at home was promoted in seminars to policy members, producers and decision makers was a total disaster in the end. They had more than 1000 visitors in three days but the initiative was focused on the public sector, not the private sector, and this was the problem. New models of the service and care economy must involve private as well as public profit and non-profit stakeholders. The service quality can only be guaranteed if there is a common way of problem thinking.

The opportunities for technology to support society in dealing with the increasing cases of chronic diseases are massive. Technology can offer support in the field of education, motivation, social relationships, rehabilitation and reproducible exercises. Of course it is a challenge to bring this support into homes, but home-based rehabilitation can be a future opportunity for the 70+ age group. It is important to slow down the process of diminishing mobility. The effect can even be enhanced in group-based settings through the motivational factor. It is still seen that in a lot of European countries the technological support for health, especially for elderly people, is not available in a broader range especially for the elderly. Often there are practical problems for elderly people when they want to use the ICT in our society, because the technology is not developed with them in mind. The older generation today are not familiar with computers and therefore are very dependent on the younger generations to access services online (e.g. e-banking, e-shopping through answering machine etc.). The question is that while technology often gives opportunities, is the age of users really taken into consideration always?

4. How can we manage it so that people can use a service? How can we make it available and appreciated by them?

The question is: How can we deliver sustainable care and give the opportunity for carer providers to make a successful business out of it? Companies that want to create a certain business in the field of AAL need to have a consolidated concept. Most of the project examples are at this stage. An independent evaluation of the project and the project results is important. Often the project and its exploitable results have been designed by people who are very enthusiastic about the project. They tend to downplay the problems and highlight the benefits. Hence independent evaluation is essential for go or no-go criteria before the product is ready for the market. Many projects at the end forget about this important step.

As a second step it is important to clearly define and to implement the business and marketing plan. Often such a solution is an application in combination with a device fulfilling a certain functionality. But when preparing the business plan it is important to change the way of thinking – to take a step back from the application itself. The application has to be part of a full service, a part together with other applications. You have to think about the context and the environment in which you want to place your application. Individuals (end users) but also society are the purchasers and they are only interested in the service – certainly not the device or application.

The next step is the prototyping: the moment where we really get into contact with the reality and the market. A marketing plan for the practical implementation in the market is essential. Often at this stage you are confronted with a lot of problems. The steps of prototyping are very expensive and you have to think about ways to deliver the products, production cost, logistics etc. An advantage here can be to start with a small scale. Even just in one country. In this way it is also easier to reach a level of trust, trustability and accountability. It can then be extended from the local scale to a wider scale. These steps can be seen as essential to bring solutions to the AAL market.

In conclusion it has been said that we should think of and focus on services we would like to use. The service must provide added value to the customers and all the stakeholders must be engaged in that. The service must be easy to use and the relationships between users-clients and payers should be clearly established. How would the home look that we want to live in? We pay for a project of life not for certain products and services. We should create wider knowledge and shared common sense between all the different stakeholders.

TRACK C PAPERS

CHARACTERIZATION AND COMMUNICATION OF AN AAL BUSINESS MODEL

Jana Clement[1], Joern Ploennigs, Klaus Kabitzsch

Abstract

To establish AAL systems in practice it is necessary to overcome the technological barriers formed by stigmatization, violation of privacy, initial costs, and usability. One important step is to cross-sell AAL systems with non-AAL services that are useful to all generations. This enriches AAL with additional uses that are not related to stigmatization, that add monetary benefits, and that provide an initial low entry point. "Services at home" are openly accepted by younger generations, who are more easy to address, and thus they can become accustomed to AAL applications. The German project AUTAGEF serves as a case study for such a cross-selling approach. It uses smart meters for behaviour monitoring (AAL) and energy management (non-AAL). This combines several benefits. First, smart meters are required to be installed by law in Europe, which results in low-cost devices. Second, the remote data access for smart meters is a regulated and secure process (violation of privacy). Finally, energy management services permit the return on investment through energy cost savings. This approach is tested by a large housing corporation with young and old tenants. The paper will describe the problems potential AAL users have to face and will introduce the business model of the project AUTAGEF. Furthermore, the paper explains a good way of communicating an AAL service and presents first results from the case study with volunteering occupants.

1. Motivation – Requirements of elderly people

Ambient Assisted Living (AAL) serves all persons who need help in their daily life. While the first AAL products are already available, their usage is still hampered for different reasons. Firstly, users have to face *high costs* starting with the investment and installation costs and further running costs for services and maintenance. This is a critical point, as most AAL users do not have large financial reserves and health insurance policies only cover the costs for medical systems, a situation that is unlikely to change in the next few years. Secondly, as long as AAL systems are mainly developed to help only impaired, old, ill or disabled persons, they will have a *stigmatization* problem. However, AAL systems can help everyone. A young mother will be glad to have a system helping her to manage her busy daily routine. Thirdly,

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AAL products are often highly developed technical products that, in their complexity, are not easy to access and control by the target user group of elderly people who are less used to technology. An AAL system's *usability* has to meet the AAL users' requirements and should be intuitive, self-explaining, and multi-modal. This also relates to the stigmatization, as users do not want to be reminded of their impairments all the time. Thus, the system should be non-obstructive and best neither worn on the body nor visible in the apartment. These aspects increase the fear of a *loss of control*. As the users cannot fully understand the highly developed technology, they are afraid of being controlled by the technology and not remaining self-determined. Even if the AAL system has no active influence on their life, the collection of private information by the monitoring systems still leads to an potential *violation of privacy*. All these problems contradict the original intention of AAL, to provide a system that helps the users to feel save. The problems need to be solved to successfully establish AAL system in the market. This paper will introduce the business model of the project AUTAGEF as one concept to overcome the technological barrier formed by high cost, stigmatization, usability, loss of control, and violation of privacy. First experiences of the communication with users will be introduced. The paper concludes with a guideline of how to develop an AAL business model.

2. Project AUTAGEF – a case study

The AUTAGEF project (Automated Assistance in Health Critical Situations) [6] was initiated in 2010 to develop a low-cost, non-obstructive monitoring solution for single apartments to detect health critical situations. The project is funded by the BMBF, the German Federal Ministry of Education and Research. The project consists of three parts. First, AUTAGEF will provide a low-cost monitoring system that is based on common smart meters used for monitoring the domestic consumption of electricity, gas and water. Smart meters provide high data resolution that makes it possible to identify individual home appliances by their peculiar consumption profiles. The resulting event series can be used to extract human behaviour profiles based on inactivity diagrams [3] and Semi-Markov-Models [2]. By analysing and monitoring such profiles, abnormalities can be detected and alarms can be raised to request help. The consumption data can also be used for energy management. Especially the use of electricity and heat can be optimized to reduce costs by changing the user's routines, optimizing controls, or replacing worn-out equipment. The second part of AUTAGEF uses more and higher qualified sensors to upgrade the monitoring system depending on the occupant's requirements. Acoustic sensors serve as one example. They can be used for hands-free, speech-based user interfaces that are easy accessible. Another use case is the detection of special sounds and noises, such as a person crying out for help or falling down. The third part considers continuous system upgrades as the requirements of aging users change. Thus the AAL system needs to evolve from a low-cost system that provides energy management and comfort features to a young family to a highly specialized monitoring system for an elderly person living alone. This requires a modular system design in which sensors and algorithms can be replaced. The complete system is being evaluated in a field test in Dresden, Germany, by a large housing corporation. During the test period of one year the housing corporation will serve as a central unit to take care of the occupants and to arrange surveys that test the acceptance and usability of the system.

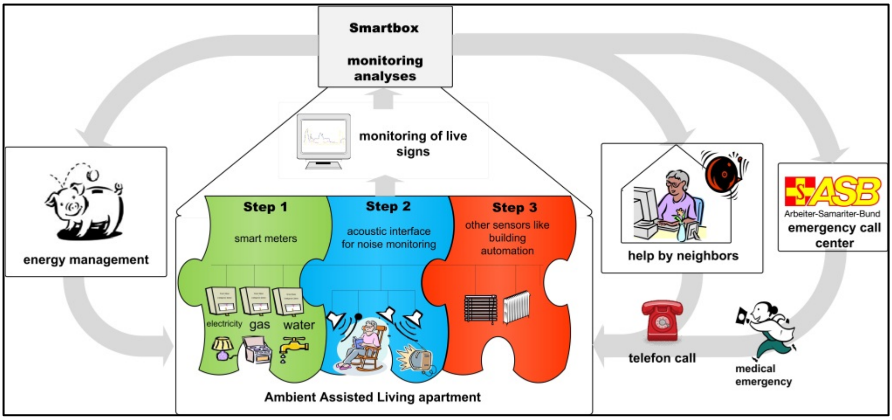

Figure 1. Overview of the AUTAGEF project. The middle section represents a user's apartment with the extendable monitoring system. The data is analysed by a so-called Smartbox. The data is used for energy management (left) as well as for emergency detection (right).

Figure 1 presents an overview of the AUTAGEF project. The middle section represents an occupant's apartment with the extendable monitoring system. It develops in the given example from simple smart meters (Step 1) over acoustical sensors (Step 2) toward a full building automation system (Step 3). The meter data is logged and analysed by a so-called Smartbox. This small box is installed next to the smart meters that are commonly hidden in the apartment. The box is thus not noticeable by the occupant or visitors. The stored data is used for energy management, as shown on the left side of the figure. It is planned that the saved money can fully finance the AAL service. Furthermore, the data is analysed to detect health critical situations, which is illustrated on the right side of the figure. In case of emergency, the alarm can be raised with several people. The sequence can be configured by the occupant. The picture in Figure 1 depicts neighbourly help as an example of the first step, as in many cases AAL users have been living for several years in their flats and have established relationships with helpful neighbours. These communities should be supported, as is done in AUTAGEF. The next person could be a family member or a close friend who lives farther away. As last resort and in serious cases a 24/7 medical centre is called. This cascade not only reduces costs for the AAL service as professional help is called last; it also helps the occupant, who is more confident with a neighbour or relative than with a stranger.

3. Business Model

The novel idea of the AUTAGEF project is to cross-sell a behaviour modelling AAL service with a non-AAL service for energy management as shown in Figure 2. In general, the non-AAL service should be a service that is used by all generations and easy to explain to others such as friends and neighbours, to overcome the stigmatization of AAL products. The energy management used in AUTAGEF is very reasonable in that regard, as the current rising energy prices, the climate problems, and the on-going debate about green technology makes energy management even fashionable.

The AAL system should permit a low-cost entry to be broadly applicable. Smart meters are such a technology as they are a mass product and are required to be installed in European houses by EU directive [1]. Smart meters are non-obstructive and do not require any structural changes inside the apartment. Thus there is no point for stigmatization, because every person's apartment will be equipped with smart meters. Wireless sensor systems are another example with at least lower installation costs [4].

It is beneficial if the non-AAL service reuses the same hardware, to add monetary benefits. The energy management in AUTAGEF reduces the costs for electrical energy, water and gas. Savings of up to 30 % [5,7] would cover not only the running costs of the systems for monitoring and emergency calls, but also permits a return on investment within five years, which is a reasonable time horizon for the user group. Thus the non-AAL service finances the AAL service. The currently on-going changes in the energy market, renewable energy sources, new storage concepts (e.g. electric cars), and highly networked smart grid infrastructure, will also offer additional services in a flexible energy market.

AAL services and non-AAL services further have to avoid the fear related to the violation of privacy. This requires beside secure data access also regulations about what data is sensitive and at which level it is monitored, stored, and exposed. AAL services deal with very sensitive data beginning with sensor data such as audio and video recordings, to detailed behaviour profiles of the user, and confidential medical data. Not only AAL service providers are interested in interfaces to the homes and flats, but also energy providers, telecommunications companies, and marketing companies show strong interest in accessing such data, not to speak of criminals, who may directly see if somebody is at home or not. The data collected from the smart meters in the smartboxes in AUTAGEF is for that reason not externally accessible. The data is locally processed to decide about emergency situations. In such a case the box will send a short message with the detected situation only. The remaining data will only be visible locally to the occupant, the AAL user.

Related to that concern is also the fear of loss of control. It is a sensible question how much control an AAL system can and should have over a user. This involves, for instance, cases of direct access of the system to the building automation, to automatically turn on the lights in the bedroom to wake a person who seems to be sleeping to long. It also has implicit impacts, such as a user becoming afraid of sleeping a few minutes longer in case the monitoring system creates any false alarms and notifies the neighbours, with the result that the person does not sleep well at all. AUTAGEF uses a night-day detection to avoid such issues.

The cross-selling of the monitoring and energy management services provides a first low entry point to the field of home services. Particularly energy management is a service that adds significant benefit to the AAL. It is useful also for younger generations and, thus, allows them to get used to the system without stigmatization. Equally also other non-AAL services that provide financial benefit to the potential AAL-user can strengthen its usage. Figure 2 summarizes the advantages of cross-selling.

4. Communication

Most of the abovementioned points are related to the psychological reception of AAL by the users. Therefore, communicating an AAL service is a very sensitive issue. The right way and words to communicate AAL services need to be found to overcome the initial fears of would-be users. As AAL is a topic that is still mainly discussed in science, most users do not know of any central facilities to become informed about AAL at all. Most potential AAL users do not even know that AAL exists. So, the questions arise such as: How should the potential AAL user get informed about his or her options? Who should inform him?

It is questionable whether external, technology-based vendors have a good chance of successfully selling AAL services on a large scale, as they often have a technology-centred view of their products. Organizations that are close to the AAL user and already offering social services may be more successful as distributors of these services. Such organizations can provide enough confidence to encourage potential AAL users to finally use an AAL service. A contact point could be any organization serving social, medicine or care aspects.

Potential AAL users are usually living alone and need support mainly at home. Thus, most of the AAL services are home-related and the communication partner for home-related issues is often the housing corporation. Therefore, housing corporations are one potential contact point for AAL services as well as non-AAL services. This combines several advantages. First, the housing corporation is close to the AAL user. The corporation knows their tenants and has the possibility to promote AAL services by sending letters or inviting users to informative meetings. Experiences in AUTAGEF have shown that it takes time for occupants to become informed about AAL systems and agree to volunteer in field tests. It served best in AUTAGEF to let the information be spread by word-of-mouth. Second, the occupant has only one contact person instead of contacts with the many different firms that are necessary to cover the whole service chain from planning, installing, and operating the individual components of the AAL system. The third advantage is that the housing corporation is already a trusted organization to the AAL user, who in turn can benefit from the experiences the corporation has already gathered. Housing corporations on the other hand are strongly interested in AAL services to increase their attractiveness to elderly residents, which are often very good tenants who pay their rent in time and create no trouble.

The non-AAL service is communicated first to the potential AAL user in AUTAGEF, to avoid the stigmatization associated with AAL services and to address a broader range of users. This helps to reduce the initial barrier of using home-related services for the first time. In a second step the AAL service is promoted. It is communicated as advantage for the young as much as for the elderly. One example is that a busy young mother can forgot the cooker as easily as a senile elderly person. Both may benefit from a service that alerts them if the cooker is on for too long. It may not be easy to identify such examples, but there needs to be a rethinking in the area of AAL: AAL is not only for old, impaired, or ill persons; AAL is useful for all. Only with such rethinking will AAL services lose their stigmatization and fear. This needs to be propagated all the time.

5. Test Field

The concept of the AUTAGEF project is tested in several steps. First, the system is implemented in a living lab at the University of Dresden and later in apartments owned by project colleagues before the final field test will be performed in several apartments of volunteers. The field test is led by the biggest housing corporation of Dresden. In preparation, the corporation periodically communicates the project's aims and results to find volunteers. This process started early in the project as it required time until the first occupants agreed to volunteer. The use of AAL services at home is based on trust in the AAL service and the technology used. To gain this trust the occupants must be introduced slowly and step-by-step to the new idea. The best promotion is the spread by word-of-mouth from neighbour to neighbour. To encourage that, the housing corporation holds occasional information seminars such that the topic of AAL becomes conventional.

The first reactions from the occupants have been collected in the AUTAGEF project. These were rather reserved, but as the information spread a high level of interest evolved over time. The occupants wanted to learn more about the project and showed the earlier mentioned fears. These fears were overcome by patiently discussing the issues and demonstrating the functionality of the system in detail. One way to do this is by building show rooms. Many housing corporations already use such rooms to present the different styles of flooring and wallpapers. One room is used in AUTAGEF to integrate a simulator for the different AAL services and sensors. Thus the occupants can see and test on their own how unobtrusive the sensors are and how the alarm system works. The word "alarm" alone can worry the occupants, because an alarm is commonly known as something loud and very public that will alert everyone in the house that someone in apartment 5b has made a distressing mistake. However, after the occupants actually could test the process of the alarm generation they became more confident. Finally, a wide range of occupants volunteered, from students interested in the technology to elderly people who wanted to live longer in their homes. Currently the first tests are running in single family houses that are inhabited by young families as well as seniors. This proves that AAL services can be used by everyone, independent of their age.

The housing corporation stays in close contact with the occupants all the time and the volunteers, as well as other occupants are informed periodically to convince even more occupants to take part in the field test. The remaining housing corporations of Dresden are also quite interested in the project's findings and are kept informed via their network organization.

6. Guideline and Conclusion

"Services at Home" are not yet established. To overcome the barrier formed by the preconception of stigmatization of the elderly and health-impaired, high costs, usability, loss of control, and violation of privacy, a cross- selling approach was presented in this paper. To successfully offer an AAL service it should be combined with non-AAL services that serve all generations. These non-AAL services will create a low entry point to the field of services at home and should bring benefits to the AAL user that should also help to fund the AAL service. As an example, the cross-selling approach of the AUTAGEF project was introduced in which monitoring AAL services are combined with non-AAL services for energy management.

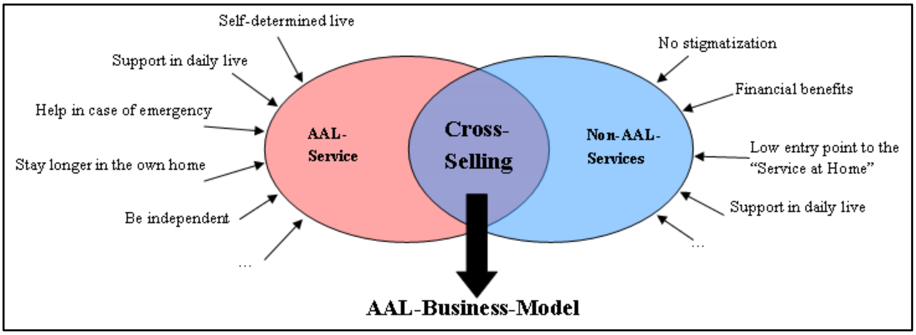

Figure 2. The advantages of cross-selling a combination of an AAL service with a non-AAL service to lower the initial barriers for potential AAL users.

Reusing the technology for multiple purposes is recommended. In AUTAGEF the smart meters and sensors can be used for both services, AAL and non-AAL. This reduces the costs, installation time and maintenance of the whole system. It is further advisable that the technology is known to the AAL user from other appliances such as television or telephone. This improves the understanding of its functionality and the usability. Meters are commonly known and the remote access is a regulated and secure process.

The communication of AAL products is a very sensitive issue. It should be done by only one institution. The AAL user should not need to negotiate with all the organizations that are links of the service chain. This communication partner ideally should be an organization with established contact with the AAL user that is associated with social, medicine or care aspects. In AUTAGEF the monitoring service is developed to help occupants in their apartments. Hence the best choice is the housing corporation managing these apartments. This works well, as it is based on the established mutual trust between the occupants and the corporation.

The worries associated with AAL should be communicated and discussed openly to make AAL conventional. It will take a long time until a new technology like AAL can become fully established in daily life. Show rooms work well to demonstrate and to encourage interested AAL users to try the technology and experience the service process. The housing corporation of Dresden will restructure their show room, which they used previously only to present different kinds of flooring or wallpapers to the potential occupants. The show room will serve as a simulator for alarms and is practical to explain the new technology.

The following list summarizes the given guidelines:

- Cross-selling of AAL service and non-AAL service
- Low-cost devices with potential to subsidize the services
- Multiple use of sensors and technology and reuse of established devices
- Service should be non-obstructive
- Loss of control and violation of privacy should be avoided
- One communication partner, social and close to the AAL user
- Periodical information seminars
- Show rooms
- Patience

Acknowledgment

This work originates from the context of the research project AUTAGEF (promotional reference 16SV4012), funded by the German Federal Ministry of Education and Research, due to a decision of the German Parliament.

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INDEPENDENCE, RESPECT AND EMPOWERMENT VIA SOPRANO USE CASES

Ilse Bierhoff[1], Bas Goossen[1], Claire Huijnen[1]

Abstract.

The European research project SOPRANO[2] (Service-oriented Programmable Smart Environments for Older Europeans) developed supportive environments for older people based on the concept of ambient assisted living (AAL). The focus of the project was on providing services that would enable older persons to live independently by providing solutions that empower them and make them feel respected. Services were presented by use cases that do not merely reflect the development of a technical system and components, but include a strong reference to the social world within which the person lives. This is crucial as the key to creating useful and acceptable technology-based services is to understand how they are embedded in a person's everyday life.

Keywords: User centred design, active ageing, smart home technology, Assisted Living (AAL), iterative prototyping, socio-technical systems.

1. Introduction

The SOPRANO system is an innovative integration of several new smart functionalities in the homes of older people. These functionalities allow the SOPRANO system to be used for various purposes in different situations. However, it is intended that users should have a seamless experience in the sense that they perceive that they are supported by a single system. A major aim within the project has been to move away from technology-push and problem-focused approaches to user-driven approaches and how to explore, visualize and map out an AAL system that will have practical benefits for users in their everyday lives.

In the final, field trials stage of the SOPRANO project, the focus was on evaluating the possibilities of the integrated system and on demonstrating the entire spectrum of factors that influence the use of SOPRANO. The field trials consisted of two parts: full

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[2] SOPRANO (Service-oriented Programmable Smart Environments for Older Europeans) was an Integrated project supported by the European Community under the Sixth Framework Programme ((IST–2006–045212). Website: www.soprano-ip.org

function trials and large scale field trials. During the full function trials the entire SOPRANO system was tested. Since the development was not completed for every single part of the SOPRANO system, feedback from users was gathered as input to the design process and/or as evaluation on the functionality of the total SOPRANO system. Some innovative parts of the SOPRANO technology and services were still in the design process and were not already proven to be reliable. Therefore to reduce the burden on participants, the full function trials were conducted in research facilities. During the large-scale field trials a sub-set of the SOPRANO system was installed in homes of end-users. Different service levels were used to provide support to the users during the trials.

Acceptance is a key issue during field trials, and is based on multiple factors that are described in the Smart Home Technology Acceptance Model [1]. It is important to differentiate between the acceptance of users exposed to the system for a short duration in the full function trials and the acceptance of users who experienced the system in their most natural environment and daily life in the large scale trials.

2. User involvement

The SOPRANO project adopted a user-driven approach to ensure that technological development is usable, useful and acceptable in the everyday life context of older users. Research, development and design by, with and for users was implemented at all stages of the product development lifecycle. The focus on in-situ use of SOPRANO facilitated a move from a health and social agenda that emphasizes dependency to one that promotes active ageing and creates supportive environments to enable healthy ageing in the settings where older people live.

In terms of evaluation different perspectives are used. The benefits to the older person are evaluated in terms of well-being, perceived independence and increased participation. Informal carers are seen as the older person's support network and can benefit from SOPRANO in terms of reduced anxiety and reduced stress. Care professionals are the formal carers who often on a day-to-day basis offer care services to the older person. They could benefit in terms improved quality of service. Care management is involved in the integration of SOPRANO in current care provision. This could lead to reduction in costs, e.g. reduction in hospitalization. Representatives from the building and technology sector focussed on the integration of SOPRANO in new and existing buildings to improve market value of the property.

The Experience and Application Research (E&AR) design methodology adopted in SOPRANO involves research, development and design by, with and for users, involving users in all stages of a product development lifecycle, not just at the end phases. In total the SOPRANO E&AR approach comprises four instances of active user involvement and starts with the elicitation of basic service requirements. On the basis of an inventory of situations that can threaten the independence of older people, focus groups were carried out with the aim of formulating a list of key challenges to independence that was in turn used to formulate the first version of the SOPRANO use cases. Multimedia mock-ups and theatre plays were developed to show the use cases to users in the course of the first prototype tests. Outcomes of these tests were used to refine the use cases, based on which the user-facing components of SOPRANO were improved. The improved components were the subjects of the second prototype tests that led to a further improvement of the component design. The last step was a field trial where the system was be installed and tested in laboratory and home settings (see Figure 1).

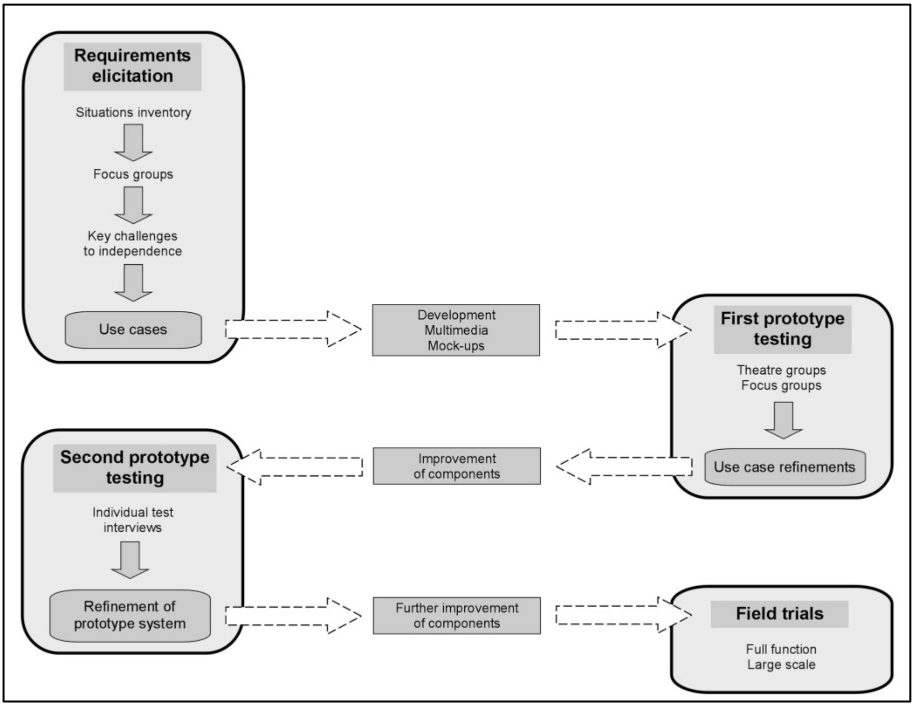

Figure 1. Iterative development process in the SOPRANO project

3. SOPRANO use cases

The following use cases (in bold) were used in the SOPRANO field trials; in brackets the type of field trial per use case is mentioned. The use cases were developed through active involvement of users.

Medication reminding (full function and large scale) addresses older persons experiencing light to moderate forgetfulness who also have to take medication at regular intervals and is targeted at improving adherence. For many older persons, the ability to remain independent in one's home depends on the ability to manage a complicated medication regimen [2]. The full benefit of many effective medications that are available will be achieved only if patients follow the prescribed treatment regimes reasonably closely [3]. Poor adherence to medication regimes, particularly for the ageing, contributes to substantial worsening of quality of life, disease, death, and increased health-care costs [2-4]. Reminders have been found to improve adherence [4-5].

Remembering (full function and large scale) addresses users experiencing increasing forgetfulness in daily life situations such as leaving the house without closing the windows or terrace door, forgetting the house key or leaving electrical appliances (TV, lights etc.) running, but also forgetting important appointments. From research it appears that older persons especially are worried about their diminishing memory [6]. Older persons feel less in control of their memory functioning than younger people [7] and they are more upset than younger people when they forget things of everyday life [8]. A variety of authors identified the loss of personal independence as a major concern of most elderly people [9-12]. More and more AAL projects address these needs by designing applications that explicitly aim at increasing safety and well-being for elderly users [13].

Exercise facilitating (full function and large scale) focused on helping older people to improve their general fitness level by regular training. In order to improve cardio-respiratory and muscular fitness, bone and functional health, and reduce the risk of non-communicable diseases, depression and cognitive decline the World Health Organization [14] recommends adults aged 65 years and above to do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate and vigorous intensity activity. An avatar is used to show how the exercises should be performed. Several recent studies [15-16] have concluded that conversational avatars are a good tool for obtaining a more natural communication with a user.

Fall detecting (full function) addresses older persons who are rather vulnerable and at risk of experiencing falls in the home. About 30% of people over 65 years living in the community fall each year [17]. In Europe, 40% of the people above the age of 75 need medical treatment after a fall [18].

Entertaining (full function) addresses users who are becoming less and less active, and are experiencing increasing boredom and loneliness. Loneliness and social isolation are often associated with older age and have been identified as risk factor for a number of health (both physical and mental) and related problems [19-23]. When providing interventions it is important for service providers to acknowledge individual differences [24-25].

Activity monitoring (full function) addresses older people experiencing deterioration in their overall health status due to unfavourable changes in nutrition. The prevalence of malnutrition is particularly high in older people: it affects over 10% of the population aged 65 years and above [26].

Safety monitoring (full function) addresses users experiencing difficulties related to sleeping, for example, getting out of the bed and walking through the house at night, e.g. to make a cup of tea or to watch television. For many, ageing is associated with decreased total sleep time, increased sleep latency, and more awakenings particularly, in the latter stages of the night [27].

For the developed use cases, a common hardware setup was created. This common set-up supported both the complete SOPRANO system shown in laboratories (full function) as well as the sub-set of the system installed in real homes (large scale).

4. Smart Home Technology Acceptance Model

The Smart Home Technology Acceptance Model [1] is divided in three parts; 'individual', 'technology' and 'service' related. The model is presented in Figure 2.

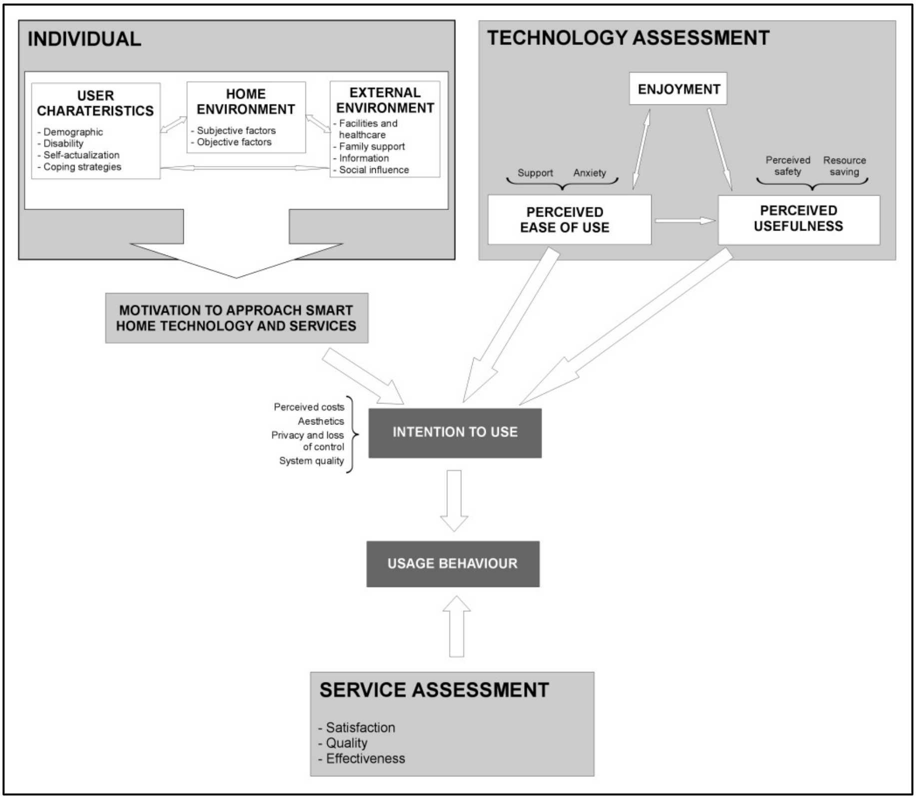

Figure 2. Smart Home Technology Acceptance Model [1]

The individual part of the model focuses on the basic conditions of the individual to make the model situation specific. It combines the characteristics of the user [28-29], the home environment [29], and the external environment [28].

The conjunction level between the individual part and the intention to use smart home technology and services is called "Motivation to approach smart home technology". It is a transaction state that could be compared to the "Felt need for assistance" of McCreadie and Tinker [29]. The characteristics of the user, the home environment and the external environment together influence the motivation of the user to approach smart home technology and services. Motivation is related to expectations, attitudes and feelings towards the system, in this case the SOPRANO system, before actually using the system.

The technology part of the model refers to the actual use of a system and its functionalities. The basis for this part of the model is the technology acceptance model with the two main factors being perceived usefulness and perceived ease of use [30]. A third factor is added, namely enjoyment, which refers to the extent to which the activity of using the system is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated [31].

Intention to use the system is influenced by the motivation to approach the smart home technology and services [32-34], perceived costs [35], aesthetics [36], privacy and loss of control [37], and system quality [35]. System quality is composed of reliability, flexibility, integration, accessibility and timeliness [38].

Intention to use the system is reported to have a significant relation with the actual usage [39]. The actual use of the system also depends on the whole chain of steps that occur behind it, it is not possible to evaluate the technological system without also taking into account the network of people that must offer assistance. In other words evaluating a smart home system requires an assessment of all other factors that it is related to, i.e. service provider and provided service.

5. SOPRANO evaluation

During the full function trials every participant filled in an acquisition questionnaire before visiting the laboratory. The questions used for these acquisition questionnaires were based upon the individual-related part of the smart home technology acceptance model. During the introduction presentation of SOPRANO, which was the starting point of the guided tour, the project and the developed use cases were explained in detail. Participants asked clarifying questions and commented on the use cases. After the demonstration of a specific use case each participant filled in an assessment questionnaire covering the technology and service assessment part of the model as well as intention to use. During the demonstration of the use cases much attention was devoted to discussing the perceived usefulness, perceived ease of use, intention to use and service provision. Minutes were taken of the discussions. During the usability tests data was collected by making notes of observations and comments when participants performed tasks while thinking out loud and comments made during a detailed walk through.

During the large-scale trials also every participant filled in an acquisition questionnaire before the sub-set of the SOPRANO system was installed in their homes. Information regarding their technical experience, their expectations and attitudes towards the SOPRANO system was collected during a pre-interview with older persons and informal carers. During the post-interview it was examined how the older person and the informal carer used SOPRANO and how it impacted on their lives. Besides these formal procedures the user and technical experts from each trial sites made notes of their own experiences related to their own role in the implementation process of the SOPRANO use cases in real homes.

An impression of the participants in the field trials is presented in Figure 3. A more detailed description of the results from the SOPRANO project will be presented in the forthcoming book *Technology for Active Ageing* [40].

Figure 3. Impressions of participation in field trials SOPRANO

Acknowledgement

The authors acknowledge the input and role of the SOPRANO consortium and would also like to thank the many people who volunteered in the various stages of user research.

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TABLETS HELPING ELDERLY AND DISABLED PEOPLE

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Abstract

The article introduces the basic principles according to which tablets are considered appropriate tools for integration and promotion of the elderly in the digital world. To prove this, the paper presents three research projects carried out by CESyA that integrate Automatic Speech Recognition (ASR), voice synthesis, subtitling, audiodescription or audio navigation tools into tablets to encourage autonomy and personal growth for the elderly and for people with disabilities.

1. Introduction

As people in many countries of the world become technologically competent, older people will be ready to use information technologies (IT) in most aspects of their daily lives [1][2].

Given the number of people who have significant impairments, and typical age distributions that show that, for age groups over 50, hearing and visual impairments become progressively common, we can safely say that the number of homes having at least one person with hearing or visual problems is very high and that it will increase in the coming years.

Among the IT devices that have been made available on the market recently, tablets are creating a great impact and almost every month a new device is announced that goes beyond previous ones in portability and performance. Touch screens are improving their performance exponentially, their responses being immediate and reliable; they support many gadgets and are able to run many applications, zoom is everywhere available, their autonomy is constantly increasing... and they are lighter that ever!

[1] CESyA and Carlos III University of Madrid

It is reasonable to foresee that in the near future most people will own and use tablets in their daily lives. They will carry them permanently and even people who will be elderly by then will also be familiar with those devices.

Tablets offer the possibility to integrate technologies that are already applied to mitigate age-related hearing or visual impairments into a single device that is affordable, popular, portable and easy to use. This is the reason why the Spanish Centre of Subtitling and Audiodescription (CESyA)[2] has been involved in different research projects to develop both applications and interaction models that are based on the use of personal devices, especially focusing on tablets, in the last two years.

CESyA is a long-term research project at the Carlos III University of Madrid financed by the Spanish Ministry of Health, Social Policy and Equality. CESyA specializes in research, training and implementation of accessibility to audiovisual media in the fields of television, theatre, cinema, education, internet and other cultural events and venues such as conferences and museums.

The most relevant technologies considered by the CESyA in its strategy are Automatic Speech Recognition (ASR), voice synthesis, and the basis to address subtitling, audiodescription, audio navigation etc. The different applications developed can turn the tablet into a guide for the visual impaired and an interpreter for the hard of hearing. Experience with new tablets confirms that this new technology could be a perfect user device and could overcome sensorial disabilities in different real-time scenarios. CESyA has developed several applications within research projects in which user experiences have demonstrated their applicability.

2. APEINTA

The first one is related to education, where tablets have been used as student devices in and outside the classroom in the scope of the APEINTA project. Other experiences based on tablets in the education field prove that tablets improve learning efficiency [4]. APEINTA is a Spanish educational project that aims for inclusive education for students of all abilities in and out of the classroom [3]. This project applies computer science to overcome barriers that unfortunately still exist today in the educational environment. Nowadays, some researchers are working on the transcription of lectures based on Automatic Speech Recognition [5]. Three different services are proposed by APEINTA: Firstly, a **real-time subtitling service** is provided, so students can use their tablets for reading the verbatim discourse of the teacher. This service uses the ASR mechanism and subtitling standards to provide real-time subtitles automatically. This service is useful for students who have temporary or permanent hearing impairments, or for foreign students, for instance. Secondly, a **text-to-speech service** is provided, allowing students with speaking problems to participate during the classes with their comments or questions. Students can use their own tablets to writing their questions and comments and submit them to the APEINTA text-to-speech server,

[2] CESyA: Spanish Centre of Subtitling and Audiodescription. http://www.cesya.es

which will convert normal language text into speech and it will be repeated aloud in the classroom with a computer voice. Finally, APEINTA provides students with an **accessible educational platform** on the internet, where every student can access pedagogical resources from their tablets at any time, regardless of their personal and access characteristics.

This project has received two awards, the FIAPAS[3] award in 2009 for research and innovation in education (provided by the final users of APEINTA) and the 2011 Web Accessibility Challenge sponsored by Microsoft: Delegates Award during the W4A 2011 Conference (a scientific award).

Students can use different personal devices in the APEINTA project, like mobile phones, PDAs, laptops (see Figure 1), etc. During the last few months, the project has incorporated the iPad as client device; users' experience confirms that iPad is widely accepted for use [6]. More information can be found at http://www.apeinta.es.

Figure 1. Laptops used in the classroom for receiving real-time subtitles of the verbatim discourse of the teacher.

Figure 2. APEINTA on iPad for reading subtitles in classroom

[3] FIAPAS is the Spanish Confederation of Parents and Friends of Deaf People (www.fiapas.es)

The experience in this area can be easily translated to other environments and users where the same impairment barriers exist, especially for hearing impaired elderly people. CESyA is extending the services based on speaker's speech transcriptions with the help of an Automated Speech Recognition (ASR) system, to the scenarios of conferences and live events where an automated audio-to-text is required. Elderly people, who in many cases cannot follow the audio or visual communications in the conference, will be able to access the captions on their personal devices (tablet PC, Smartphone, laptop, etc.). In addition, audiodescription could also be provided in the tablets without the need for special devices.

3. UC3MTitling

Another experience lies in the field of captioning in theatres, where the use of tablets to show subtitles has been successfully tested as a valid alternative where screens on the stage are not possible. Carlos III University in collaboration with CESyA has developed an application to support different accessibility services in tablets and other devices. UC3MTitling is a software tool which incorporates the necessary procedures to control, on site or at distance, the synchronized projection of accessibility elements (subtitles, video for sign language and audio description) through the different channels associated with the theatre where the play takes place. This system creates subtitles in the real time of events for an audience, without the need for highly qualified personnel. Its area of application is live events based on a pre-established script such as theatre, conferences, ceremonies etc., which allow the synchronized broadcast of any accessibility element for a live event as it unfolds, and at a low cost. This subtitling system not only allows individuals with impaired hearing or sight to able to follow such events, but the rest of the audience can also benefit from them, thereby achieving complete integration for disabled persons and conditions on par with the rest of the audience.

The main advantage of this system is that the technician can carry out the synchronization of the elements without actually having to be in the theatre where the performance is taking place, with the use of an Internet connection. In this way, once the technician begins broadcasting the accessibility elements, they can be broadcast in the theatre by different channels depending on their features; texts for titles, audio for audio description and video for sign language. In addition, because of the high degree of compatibility of the chosen formats, the audience can simultaneously consult them from different devices; tablet, Smartphone, PDA, etc. The use of tablets and similar personal devices for subtitle display allows in addition the use of different subtitle languages, selectable by the user.

UC3MTitling has been successfully tested in several performances and included in regular theatre representations at the Centro Dramático Nacional (CDN), in the framework of collaboration with CESyA whose aim is to set up functions of this type on a regular basis during the 2011-2012 season of the CDN programme. This agreement is within the framework of social awareness and action for accessible culture that the CESyA is carrying out.

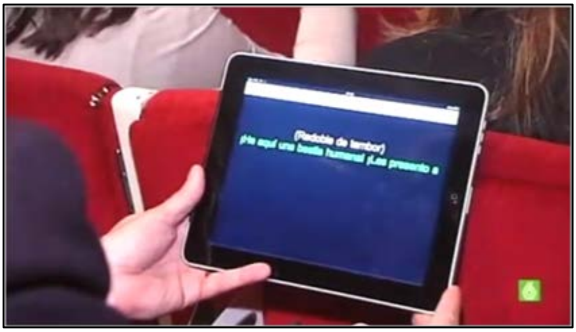

Figure 3. UC3Titling being used live in a theatre

UC3MTitling and several user interviews appeared in the news on the Spanish television channel la Sexta in relation to the CDN performances: http://www.youtube.com/watch?v=8DI8GKhn3KI

4. GVAM

An application for tablets and associated technologies has also been developed: GVAM is a research and commercial project carried out by CESyA and Dos de Mayo company for the development of multimedia accessible guides (MAG) for museums [7]. GVAM is a management and publishing system for contents and guided tours designed specifically for exhibition spaces like museums or fairs. It aims to facilitate and expand publication and edition techniques for these institutions in an accessible manner. This integral technological solution to cultural spaces is being already implemented in several museums in Spain. GVAM has been developed in collaboration with associations of people with disabilities and the Ministry of Culture. After five years of work, GVAM offers a unique system that ensures the accessibility to all the contents and interfaces for the general public, not through alternative means, but universally.

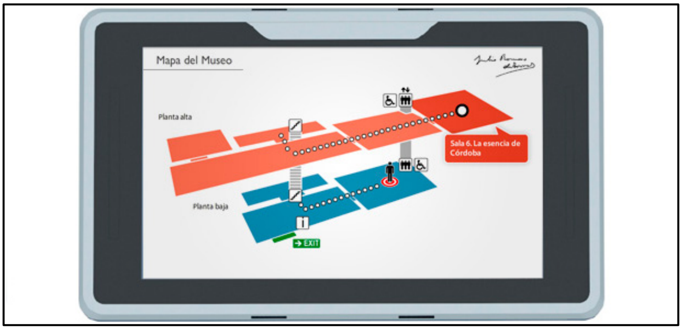

Figure 4. The GVAM Accessible Multimedia Guide

The GVAM Spanish technology is supported, from the beginning, by a clear vocation for experimentation and innovation. It has its own technology, both hardware and software, ensuring maximum versatility in customizing and publishing the application.

The GVAM application makes accessibility to guided tours possible to people with sensory disabilities by means of several accessibility resources that every visitor can freely activate to adapt to her or his needs. Some of them are real-time subtitles, audio description, audio navigation, sign language videos, high contrast option or magnifier, all of them synchronized on the same device. GVAM guides have an indoor location system that allows visitors to find their position in the exhibition space at all times and know how to reach places of interest. This system is especially useful for blind people. The GVAM guides can also offer itineraries based on time available, interests, subjects, or didactic criteria adapting the contents to other groups like children and people with mental disabilities.

Its online CMS (Content Management System) allows the multimedia application to be exported not only to the GVAM mobile guide but also to all types of mobile platforms, websites and social networks. In addition the CMS has two important automatic content generators, one for synthetic speech in several languages and one for subtitles. This enables the museum staff to update and extend the accessible tour guide quickly and in a more economical and efficient way. For more information, see: http://www.gvam.es/

5. Synchronized Subtitles in Live events

Tablets are also suitable devices to present synchronized subtitles that result from the real-time processes required for live subtitling in conferences and live events where a pre-recorded script is not available. Subtitling of live events is a complex and expensive process where the required immediacy limits the quality of the result in terms of content and speed. As a result, subtitle synchronization is a challenging issue in accessibility to live multimedia that is especially relevant as subtitles delay with regard to the audio have a disturbing effect on users that has a great impact on the audience in terms of comprehension when subtitles are presented on the screen several seconds later than audio/video. To solve this problem, University Carlos III of Madrid has developed and patented a model for real-time synchronization of subtitles and audio/video that allows subtitles generated by means of Automatic Speech Recognition tools to be displayed on screen several seconds later but individually aligned [10]. The model allows the synchronization of subtitles to audio before reproduction, compensating the individual delays produced when obtaining subtitles from speech in real-time, so that users that require subtitles may have the option to experience a quasi-live synchronized alternative. Key aspects of the proposed solution are the techniques to calculate individual subtitle delays with regard to the audio and video, and their use to create a slightly delayed version of the live television programme with synchronized subtitles. One of the scenarios where this approach fits better is the use of tablets in live conferences or events, where tablet resources (screen and audio) can be used to provide elderly or disabled users with a synchronized version of the audiovisual scene. This synchronized version occurs several seconds later but has the advantage of subtitle-to-audio synchronization in a personal, non-disturbing device, while allowing people to enjoy the experience of being present at the live event together with the rest of the audience. The application of real-time subtitle synchronization in tablets to improve accessibility in live events will be received as an improvement for an increasing number of people, and the CESyA continues its research lines in this area.

6. Conclusions

These experiences can be considered as a base to deal with similar situations where audovisual and interactive accessibility resources like subtitles are created in real-time in conferences, guided tours, etc. When combined with the automatic speech recognition and speech synthesis capabilities developed by us, or already integrated in many of the tablets available today, the use cases for visual and hearing impaired people are endless. Subtitling, audiodescription, voice synthesis and automatic speech recognition are necessary complements to growing acceptance of tablets among elderly people nowadays as a support and communication tool. An example may be found in:
http://news.yahoo.com/s/ytech_gadg/20100423/tc_ytech_gadg/ytech_gadg_tc1762.

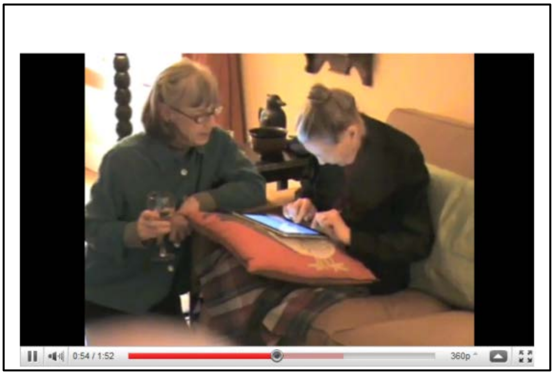

Figure 5. Frame from "Virgina's new iPad" video.

The Spanish Centre for Subtitling and Audiodescription (CESyA) is a Public Reference Institution under the Royal Board on Disability of the Ministry of Health and Social Affairs and is co-funded by the Carlos III University of Madrid. CESyA is a multidisciplinary research project led by Carlos III University of Madrid to promote wider accessibility to audiovisual media through the services of subtitling and audio description. Its most relevant objectives are the research, training and contribution to initiatives in standardization, communication and social awareness of audiovisual accessibility in the fields of digital television, cinema, theatre, internet, education and other venues and cultural events such as museums and conferences. http://www.cesya.es/

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VIRTUAL REALITY AND AUGMENTED REALITY TOOLS FOR DESIGNING NEW HIGHLY USABLE HUMAN-SYSTEMS INTERFACES

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Abstract

The quality of life of elderly and disabled people can strongly benefit from highly usable human-systems interfaces. New emerging product design technologies offer many opportunities to evaluate and improve the usability of systems in the early design stages. Virtual Reality (VR) and Augmented Reality (AR) tools allow simulation of the behaviour of the user that interacts with a virtual representation of a product or environment. In this way different design alternatives can be evaluated in terms of physical and cognitive performance. In this context the present paper describes a specific research project that considers how properly VR/AR technologies can be used for designing a domestic environment. Design methods and tools and evaluation protocols are under investigation in order to set a robust inclusive design approach for optimizing human-machine interaction. This paper focuses on a specific part of the entire approach related to the use of VR/AR technology for user interface evaluation.

Keywords: usability, virtual reality, augmented reality, protocol analysis.

1. Introduction

In the context of the Italian national research programme "Industria 2015: Technologies for 'Made in Italy'" a research and innovation project has been funded (costing around 10 million €) called "*e*-kitchen: smart and highly usable kitchen". The project involves sixteen large companies including Indesit, Telecom Italia, Faber-Franke, De Longhi, Sabaf, Renesas and seven SMEs, led by Lube Industries, one of the most important European manufacturers of kitchens. Five important research centres, under the coordination of Università Politecnica delle Marche (the User

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Centred Design group), collaborate in the scientific activities of the project. The project started at the beginning of 2011.

The project aims to achieve a complete rethinking of the kitchen environment, taking into account safety, comfort, eco-sustainability and energy efficiency, but the main goal is the improvement of usability of the kitchen environment especially for elderly and disabled people. In this context it becomes essential to manage and to optimize the interaction between the user and the different devices, in order for the individual to live in an environment that offers well-being, safety and new intelligent functionalities, but also meets the "Made in Italy" style (MI). The interaction involves three elements; human, machines and environment. The project intends to study solutions in order to improve the communication between all these three elements. For instance, it implies the development of a centralized system with a high level of communication/visualization usability for supporting the remote management of all the appliances through an appropriate interface, the realization of full flexibility of the kitchen's space in order to permit 100% accessibility based on the profiles and needs of the users (with special attention to cognitive and physical disabilities), the implementation of a low-cost system for monitoring the user's behaviour in order to keep his or her vital functions under control and to activate warnings in case of need, and many other user-centred features.

In order to realize a fully inclusive design, one of the main aims is the study of new technologies for supporting the kitchen environment and systems design. Such technologies are based on immersive multisensorial Virtual Reality (VR) and Augmented Reality (AR) tools. The simulated interaction and the high usability of design technologies makes it possible to involve the end-users during the conceptual design of new solutions. In this way it is possible to achieve customized products by analysing different alternatives directly with end users. The design technologies make it possible to examine both physical and cognitive ergonomy. Specific protocol analysis methods are under development in order to examine the implicit and explicit user behaviour.

2. VR/AR technologies for designing interactive systems

In order to design a usable interactive system, understanding the needs and limitations of end users is a crucial issue. This can be achieved by adopting a user-centred perspective at each stage of the design process.

According to ISO 13407 standard [1], a proper user-centred design (UCD) process is structured in the following iterative phases: (a) identification of users' needs and establishment of requirements for product; (b) development of alternative designs to meet such needs; (c) building of interactive prototypes which can be communicated and assessed; (d) evaluation of what is being built throughout the process and of the user experience it offers.

In order to implement UCD methodology successfully in the design process it is necessary to construct interactive prototypes able to support a proper evaluation of system usability in a shorter time. The quality and the level of interaction offered by prototypes actually determine the interactivity achieved during testing [2].

Two main prototyping techniques can be classified that differ in the level of fidelity and interaction they provide. Low-fidelity prototypes (e.g. paper sketches, cardboard mock-up) are good to test aspects such as the layout of controls, but not to evaluate the effects of tactile, auditory and visual feedback [3]. High-fidelity prototypes (e.g. software-based, physical mock-up) are able to make users realistically appraise product aesthetic attributes and functionalities [4], but they are expensive and cannot be realized at the first conceptual design stage when product design has not yet been completed.

To overcome this limitation, VR-based technologies have been introduced to create, manipulate and explore virtual prototypes as well as simulate product behaviour in different working conditions. They aim to replace physical mock-ups with virtual ones [5]. Some studies demonstrate how they can be used to carry out usability testing rapidly, to reduce evaluation time and costs and to involve end-users from the earliest stages of the design process without building physical mock-ups [6]. However, VR environments often show several technological limitations as they are characterized by a low sense of immersion, poor physical interaction, high complexity, low realism, unnatural manipulation, intrusiveness and non-intuitiveness.

Mixed Reality (MR) environments represent a compromise solution in which real and virtual worlds are combined in various proportions and presented as a unified whole. MR fuses the two extremes of the virtuality–reality continuum by synchronizing information from the digital existing space and the physical one in a more natural way [7]. Within the MR framework, Augmented Reality (AR) is one of the most adopted techniques, due to the low cost of the technology and its ability to enhance the real scene with computer graphics and emerging tactile and sound rendering displays [8].

Many different solutions have been proposed with the intent of providing devices to interact with the AR environment in a more intuitive way. Some researchers integrate handheld haptic technologies to reproduce the real contact with objects during exploration of virtual space [9]. Others, in order to eliminate the gap between the interaction with a natural environment and the interaction with a computer system, adopt Tangible Augmented Reality (TAR) techniques [10]. A Tangible User Interface (TUI) uses objects of the natural environment as an interface to the computer. Thus, the real world and the virtual world are combined. This intuitive way of interaction simplifies the communication between man and machine, especially for unpracticed users.

No studies have been yet conducted to assess the optimum VR technology for the involvement of elderly people in the evaluation of design solutions. Most of the projects that aim to address the relationship between older people and technology, including UTOPIA [11], have been limited to developing a new methodological approach to design for elderly people without taking into consideration this crucial topic. However, this issue is beginning to be of great importance. For instance, it is one of the main topics of VERITAS [12], an Integrated Project (IP) within the Seventh Framework Programme, that is most related to the introduction of virtual reality testing at all stages of the design and development of assistive technology products.

3. VR/AR-based user-centred design approach

Users' involvement during the design process is particularly important in inclusive design because designers have a very different awareness of the needs of elderly and disabled users from the users themselves. However, this can be a complicated task. The general proposed design process described below (Figure 1) is based on a proper UCD methodology where user characteristics are the main driver of identification of the design solution.

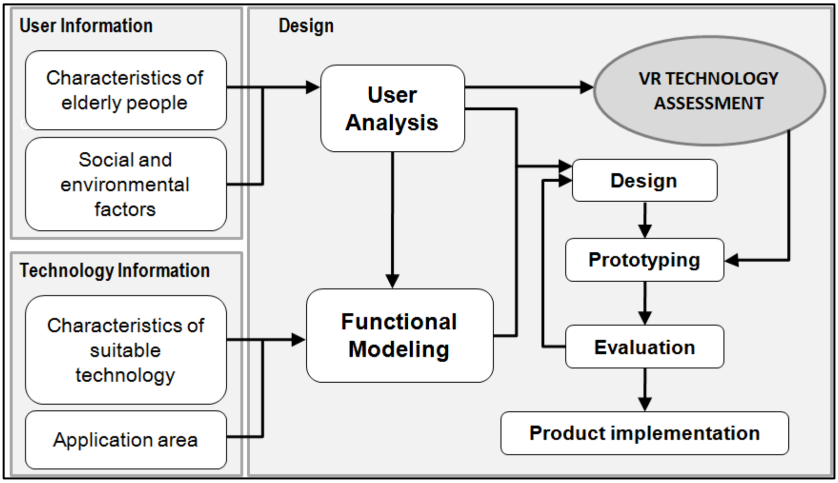

Figure 1. The User-Centred Inclusive Design Approach

The information that is required to feed into the design process is grouped into two areas. The first comprehends all information about end users' characteristics and abilities (characteristics of elderly people) and environmental and social factors that can affect their activities in their daily life (social and environmental factors). The information collected into the second area is related to the characteristics of suitable technologies (e.g. costs, flexibility, extendibility, upgradeability, etc.) and to the respective potentially valuable applications (e.g. safety monitoring, health and assistive application, communication, etc.).

User information is collected and analysed in a proper user analysis process, in order to extract user needs and preferences. Data on preferences can be gathered using interviews, workshops, surveys, site visits, artifact analysis, focus groups, observational studies, and contextual inquiry. In order to analyse user needs, it is important to underline that elderly people present a very diverse range of abilities. This diversity of ability exists not only within groups, but also for individuals, so that it is impossible to draw up a simple profile, or to identify a single stereotypical user. In this context, the *International Classification of Functioning, Disability and Health* (ICF) is a valuable tool to understand the abilities of a user depending on his/her features.

The adoption of a functional modelling approach allows structuring of system/environment functions and flows. In this way it is possible to represent the design context in terms of actions to be supported and mutually correlated. Then it is fundamental to analyse how a particular user can act in an environment according to his or her own capabilities. For example, in a typical kitchen it is possible to perform a particular set of macro-tasks, such as preparing meals, eating, drinking, doing the housework, etc. Each macro-task consists of a number of actions that require specific physiological and psychological skills to be performed. Once the functional model of the environment is built, it is possible to deduce how the lack of particular skills impacts on the performance of each task. Based on the characteristics of the technologies we can then define the characteristics of a clear set of appropriate facilitators to be provided in order to design a barrier-free concept.

Prototyping activity is fundamental in order to communicate and assess the design intent. To make effective the product experience on a virtual prototype an appropriate virtual prototyping technology has to be chosen according to the characteristics of the particular user. In fact, the experienced quality of the VR environment, in terms of interaction, immersion and navigation, generally depend on the psychological and physiological ability of the individual user. For example, an elderly person with movement disorders, as opposed to a healthy one, may not be able to operate in an immersive environment by using a gesture recognition interface.

Evaluation of product usability is fundamental for the creation of a user-sized product. It makes it possible not only to point out design errors, but also to measure the quality perceived by the user and the resulting product experience, so that the design changes can be better finalized. It is carried out through usability tests, which make it possible to acquire detailed information on the product experience and the way consumers use the product. To evaluate product usability fully, it is necessary to develop a protocol analysis which allows us to correlate the user's response to the specific product features and to consider both emotional, affective and cognitive aspects of the user-product interaction.

A preliminary application of part of the above approach has been applied in the e-kitchen project in order to study a software system-user interface, as reported in the following section.

4. Experimental case study and results

The study was conducted to assess how TAR technology can be useful in order to involve elderly persons in the early evaluation of usability of the centralized control panel of the e-kitchen model (called the *smart kitchen user interface*). The structure of the e-kitchen system is shown in Figure 2. The control panel makes it possible to manage all household appliances, to receive suggestions and feedback from them, to monitor consumption etc.

The proposed approach for assessment of product interface usability consists of the following steps:

- definition of a structured protocol to assess both the cognitive and the physical ergonomics of alternative design solutions.
- development of high-fidelity TAR-based virtual prototypes operating similarly to the final system and enabling the user to interact with the physical elements to trigger emotional and affective response;
- application of the experimental protocol to assess usability of different concepts and identification of which interface features allow to achieve the highest performance.

The TAR prototyping technique described here is characterized by a tangible interaction in the AR environment and by a functional simulation of the GUI behaviour. The tangible interaction is produced thanks to a physical prototype of the product onto which a projection of the virtual prototype in real scale is overlapped. Reliable real-time interaction is guaranteed by an optical tracking system (Optitrack by NaturalPoint) that tracks the user's hand, the user's point of view and the position of the product prototype in the same space. The modelling of the GUI functional states and the management of state changing in real time is realized by 3DVIA Virtools (by Dassault Systems). A portable clip-USB camera is mounted on the see-through glasses (iWear VR920 by Vuzix) to record the scene. Such a set-up allows users to handle the product prototype and simultaneously to see the virtual interface projected on the physical object.

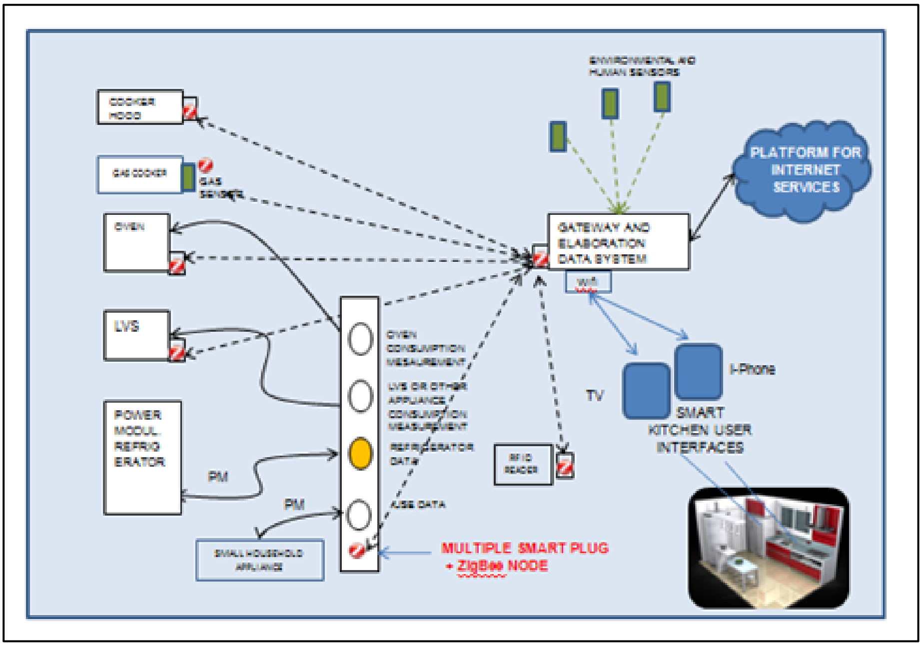

Figure 2. The e-kitchen model

Primary tests were conducted with eight users, unskilled in mobile technology, aged between 60 and 70 years. Different design solutions were analysed. For each of them a TAR prototype was created. Product usability was evaluated by task analysis. A proper set of metrics was defined by considering both the identified features and the main characteristics of the product under assessment.

Similar tests were conducted on a second group of users, equivalent to the first, adopting a traditional high-fidelity prototype.

A One-Way ANOVA was calculated in order to compare experimental data (task completion time, number of errors and satisfaction in use) in different set-ups. By analysing the results the adopted protocol has proved to be appropriate to evaluate the GUI and that the TAR prototype can be useful to investigate both cognitive and physical ergonomics due to its dual nature (i.e. virtual interactive graphic interface and physical interaction with the product body).

In particular it is possible to infer that the technological set-up does not affect task errors and satisfaction in use. However, time performance is significantly different (see Table 1).

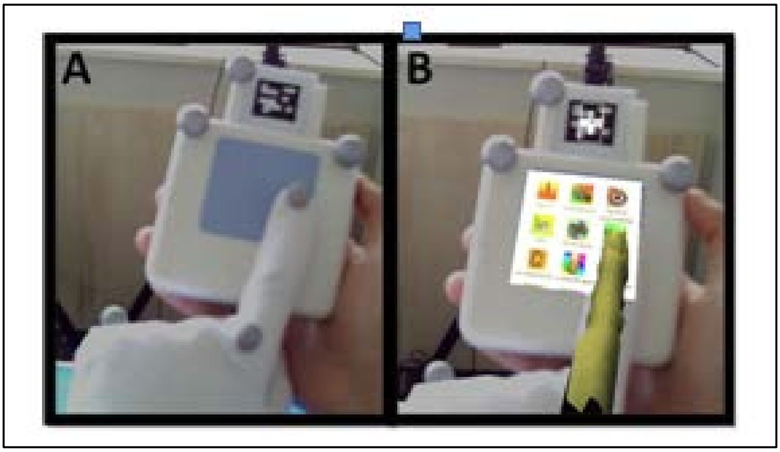

Figure 3. TAR prototype. (A) the RP model with AR and Optitrack IR marker and (B) the augmented image of interface**.**

Table 1. One-way ANOVA results for metrics of satisfaction, task completion time and number of errors

Satisfaction metrics		Mean	Std.dev.	F	Sig.
Pleasure in use	HF	4.60	0.548	2.250	**0.172**
	TAR	4.00	0.707		
	Total	4.30	0.675		
Absence of monotony	HF	4.80	0.447	1.600	**0.242**
	TAR	4.40	0.548		
	Total	4.60	0.516		
Accessibility	HF	4.80	0.447	0.400	**0.548**
	TAR	4.60	0.548		
	Total	4.70	0.483		
Easy to use	HF	4.80	0.447	0.400	**0.545**
	TAR	4.60	0.548		
	Total	4.70	0.483		

		Task completion times				**Number of errors**			
		Mean	**Std.dev.**	**F**	**Sig.**	**Mean**	**Std.dev.**	**F**	**Sig.**
Task 1	HF	5.60	0.894	22.533	**0.001**	0.20	0.447	0.800	**0.397**
	TAR	8.20	0.837			0.60	0.894		
	Total	6.90	1.595			0.40	0.699		
Task 2	HF	11.80	1.304	11.267	**0.010**	0.20	0.447	1.600	**0.242**
	TAR	14.40	1.140			0.60	0.548		
	Total	13.10	1.792			0.40	0.516		
Task 3	HF	8.40	1.140	7.692	**0.024**	0.40	0.548	1.385	**0.273**
	TAR	10.40	1.140			1.00	1.000		
	Total	9.40	1.506			0.70	0.823		
Task 4	HF	8.80	1.643	4.881	**0.068**	0.20	0.447	0.400	**0.545**
	TAR	11.20	1.789			0.40	0.548		
	Total	10.00	2.055			0.30	0.483		
Task 5	HF	15.20	1.304	10.227	**0.013**	0.40	0.894	0.182	**0.681**
	TAR	18.20	1.643			0.60	0.548		
	Total	16.70	2.111			0.50	0.707		

5. Conclusions

The use of VR/AR technologies can successfully support the design and evaluation of Ambient Assisted Living environments. In particular they can facilitate the assessment of user interfaces both from a cognitive and physical point of view. In this context an inclusive design approach has been defined in the scenario of a funded national project called *e-kitchen*. A part of this approach is related to the choice of VR/AR technology for virtually testing different software user interfaces. In this case the technology assessment has to be properly correlated to a specific class of users (aged people). The end-user analysis compared with the functional and usability features of the VR/AR technologies has allowed us to identify Tangible AR as the best system to experience the interaction. Experimentation with a group of actual target end users confirmed this assumption.

Acknowledgments

This research has been funded by the Italian Ministry of Economic Development within the Industria 2015 Programme, "Made in Italy", which involves twenty-one partners from academia, research and industry.

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GESTURE RECOGNITION INTERFACE USING A BIO-INSPIRED OPTICAL SENSOR

Matthias Zima[1], Martin Litzenberger[1]

Abstract

We present a gesture recognition approach based on a biologically inspired "Silicon Retina" optical stereo sensor, which is ideally suited for the recognition of dynamic gestures. The sensor is only sensitive to light intensity changes and therefore tracks motion in its field of view robustly and with high accuracy. The continuous track of the hand performing the gesture is analysed using a learning approach. The paper presents the system overview and the preliminary results of the feature extraction as a first step for the classification and recognition of the gesture. The hand gesture recognition software for the embedded device is developed within the AAL FoSIBLE project and will be evaluated against comparable gesture recognition solutions available for the Kinect device.

1. Introduction

Gesture recognition promises to provide a simple to use, intuitive interface – especially for the elderly – for interacting with computers or electronic systems in general. The appearance of Microsoft's Kinect 3D-sensing device has led to a boom in the development and demonstration of gesture control interfaces. However, the Kinect device itself allows just the three-dimensional scene recognition and an additional PC and software are necessary to perform the actual gesture recognition in real time. This results in increased cost and complexity of the system when deployed, because the device cannot be directly connected to a television set or set-top box. In the AAL joint programme project, Fostering Social Interactions for a Better Life of the Elderly (FoSIBLE) we aim to develop a fully embedded system for menu navigation and control by arm gesture recognition based on a biologically inspired "Silicon Retina" optical stereo sensor. The sensor is only sensitive to light intensity changes (as caused by motion in the scene) and is therefore ideally suited for recognizing dynamic gestures. In the FoSIBLE project we utilize the sensor for hand tracking as a basis for gesture recognition. The proposed embedded system will be able to distinguish dynamic hand gestures to directly control devices like TV sets or set-top boxes. In this paper we describe the current progress in developing the gesture recognition interface in the FoSIBLE project.

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The UCOS2 stereo sensor is an embedded optical 3D sensing device that was originally developed for people-counting applications. The device employs two specialized CMOS sensors of 128 x 128 pixels with on-chip signal processing and a 'blackfin' digital signal processor (DSP) for generating a depth map by stereo matching of the left and right sensor data [1, 2]. The pixels are sensitive to relative light intensity change and signal these changes asynchronously with low latency and high temporal resolution. This functionality is inspired by biology, therefore such an optical CMOS sensor is often referred to as a 'silicon retina' in the literature [3].

The device delivers the data as so-called timed address events (TAE), coding the pixel coordinates and the time of the intensity change in a stream of asynchronous vector information rather than in image frames. 3D depth information is also encoded in the TAE stream that is output from the sensor via an Ethernet LAN connection. This principle of operation allows a robust and fast tracking of moving objects within a range of about three metres in front of the sensor. The intrinsic time resolution of the optical sensor is <10 μs and the embedded software calculates depth maps with a maximum frame rate of 100 frames per second. The UCOS2 device is approximately 13 x 13 x 17 cm in size.

Tracking the object nearest to the sensor is already implemented in the embedded software of the device and the extracted tracks are also encoded in the UCOS2 sensor's TAE data stream. When moving an arm in front of the device, performing an arm gesture, it will therefore continuously output the position of the hand as being the closest object. Figure 1 shows a sequence of still images of example tracking data (left panel) and synchronous video (right panel) of a person performing a "circle" gesture with his right arm. The continuous track of the hand (see green track in Figure 1) performing the gesture is then analysed in the later processing stages.

Figure 1. Sequence of still images of an example of raw hand tracking data from the UCOS2 sensor (left pane) and synchronous video (right pane) for a person performing a "circle" gesture with his right arm.

2. Gesture Recognition

2.1 Proposed User Interface

For the project FoSIBLE an easy to use input concept is required to give the elderly users the possibility to interact with the social media platform also developed within the project. The main display device is a state of the art television set which will be used to show a graphical user interface (GUI) and the content of the media platform. The navigation of the menu is performed using natural arm gestures which are understandable and easy to learn by the elderly users. These gestures and hand motions will control the cursor "focus" of the GUI with gestures for 'up', 'down', 'left', 'right' and a 'select' and a 'return', covering all the possible interactions with the GUI. Figures 2 and 3 illustrate the proposed GUI with the menu and the gestures, respectively. Typical control actions performed with the gestures will involve menu control, like browsing up/down/left/right through a menu (see examples in Figure 3). Further actions will include 'home' and 'select' operations without the need to locate and handle an additional device like a remote control.

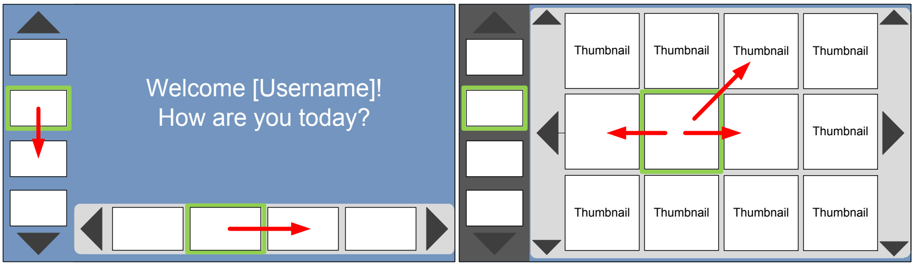

Figure 2. Typical on-screen menu structure for use with the proposed gesture control. Gestures will allow to control for browsing up/down/left/right through the menu.

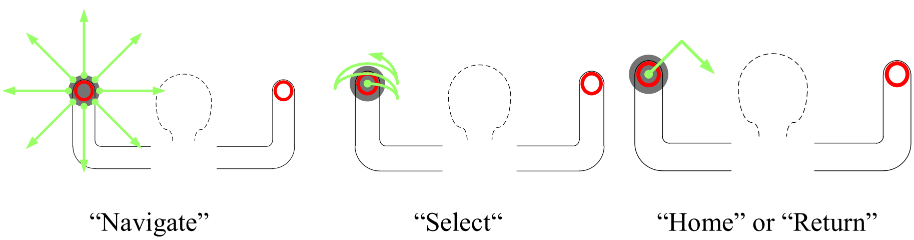

Figure 3. Proposed gestures for the menu control

2.2 System overview

The data provided by the UCOS2 sensor is filtered and smoothed. Unwanted information like noise is removed and the tracks of the detected movements refined refined, e.g. by closing gaps or removing outliers. The example shown in Figure 4 is data from a circular gesture as shown in Figure 1.

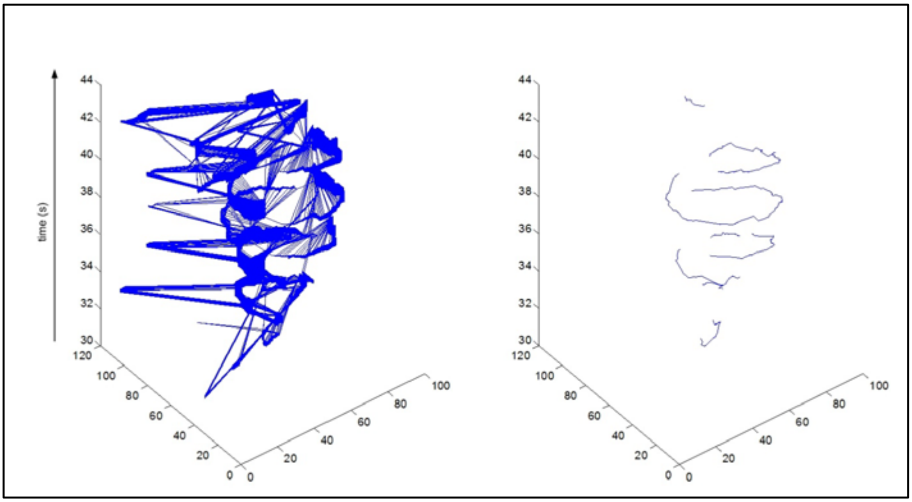

Figure 4. Sample data in space-time representation. Raw data (left) is required to achieve tracks by a preprocessing step (right).

The data are split up into auxiliary information and the tracks extracted by the sensor. Auxiliary data are, e.g., the activity in a certain zone of the field of view. The output data of the preprocessing stages are again tracks and auxiliary data, which will be used by the feature extraction units in the gesture classifier. The output of the classifier is a probability vector, containing the likelihood of the current input data to represent a specific trained gesture. The gesture interpreter selects one single gesture and outputs a corresponding command to the TV set control or other subsequent stages. The Kinect device is used as a reference sensor and Kinect-based hand tracking results will also be input to the proposed gesture classifier. However, the Kinect approach lacks the potential for fully embedded gesture recognition as it only outputs the 3D scene data. Hand tracking and subsequent gesture recognition modules have to be implemented in a PC environment.

2.3 Feature extraction and gesture classification

Figure 5 shows a detailed diagram of the gesture classifier unit. The gesture classifier system consists of multiple feature extraction units and a machine learning module (MLM). The feature extraction units use the data received from preprocessing and derive explicit features from tracks, like the track-length, speed, acceleration, orientation, Bounding-Box characteristics or activity. Most important is that the features are invariant to the size and position of the gesture in the field of view.

Each gesture is represented by a combination of some of the features. The length of a track is the sum of distance between all points of the track. Since this feature depends on the amplitude of the gesture-movement length will not be a strong feature. Speed, representing how fast a hand is moved to perform a gesture, is another weak feature, since it has on one side a big variation depending on the person performing the gesture, but there will be no big difference between the gestures. A much stronger feature is the orientation of the gesture movement, since each gesture has a distinguished direction, which can also be detected on sensor data. The Bounding-Box characteristics are the area covered by a box around the gesture movement and the ratio of the side lengths of the box. The Bounding-Box Area is not independent of the amplitude of the gesture-movement, but highly characteristic for each gesture and therefore a strong feature. Another very strong feature is the Bounding-Box ratio, which is very characteristic for each gesture. The acceleration of the gesture-movement might be used to distinguish how intentionally a gesture is performed. Features are extracted on the same time basis as the UCOS2 sensor generates the data, i.e. a sampling rate of 100 Hz.

The features are combined in a feature vector handed over to the MLM, which is based on a learning algorithm like Hidden Markov Models (HMM), Support Vector Machine (SVM), etc. For each of the gestures one individually trained module is needed. The output of the MLM will be the probability vector P. For training purposes the classifier will receive the ground truth information, produced from test recordings, from the test and learn control.

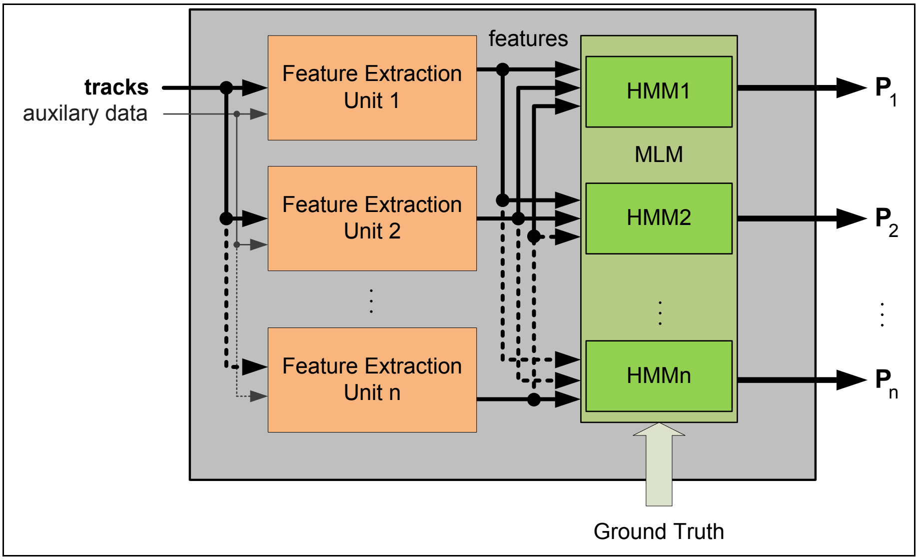

Figure 5. Detailed architecture of the gesture classifier module.

2.3 Preliminary results

The training of the MLM is an essential part of the work in the development of the gesture recognition system. As it would be unacceptable for each user to have to train the system to his or her way of performing the gestures, a large dataset of training data has to be recorded for this purpose. These training data sets must contain a large variation of example data for each gesture with variations in, e.g., the light conditions, age of the user, distance and angle with respect to the sensor, left- or right-handedness of the user, etc. The amount and quality of the training data will determine the robustness and the quality of the gesture recognition. Current estimation expects that in the order of 1000 training data sets are necessary to achieve a sufficient training of the system.

Test data for about twenty repetitions of each gesture were collected. Figure 6 shows a set of sample set gestures and extracted features. The extracted features *track length, orientation, bounding box ratio and bounding box area* for the first five seconds of each track are shown in the four rows below. Significant feature values representing the strong features are indicated by black circles. It is also clearly visible in Figure 6, that the orientation (angle) is a strong feature, since there are accumulations at certain angles. Also Bounding-Box Area and Bounding-Box Ratio are highly characteristic for each gesture. As mentioned earlier, the length of a gesture is a weak feature, as it is clearly visible, that the length looks almost the same for each of the gestures.

3. Conclusion and next steps

The results acquired so far show that it is possible to use the UCOS sensor to detect characteristic tracks, which can be used to extract features for gesture recognition. Further features will be extracted and analysed to determine the strongest features which will be used for a classification by a machine learning mechanism, respectively Hidden Markov Models will be used. After implementation and evaluation of the results, the gesture recognition will be implemented in the embedded software of the sensor. The sensor will then be an embedded gesture recognition device, not requiring a PC or other external hardware, enabling a broad spectrum of applications. The hand gesture recognition software for the embedded device will be evaluated against comparable gesture recognition software available for the Kinect. In addition to gesture recognition, the device is able to provide information on the “social status” of the user. It can recognize if the user is in front of the TV set, if the user is in company or alone.

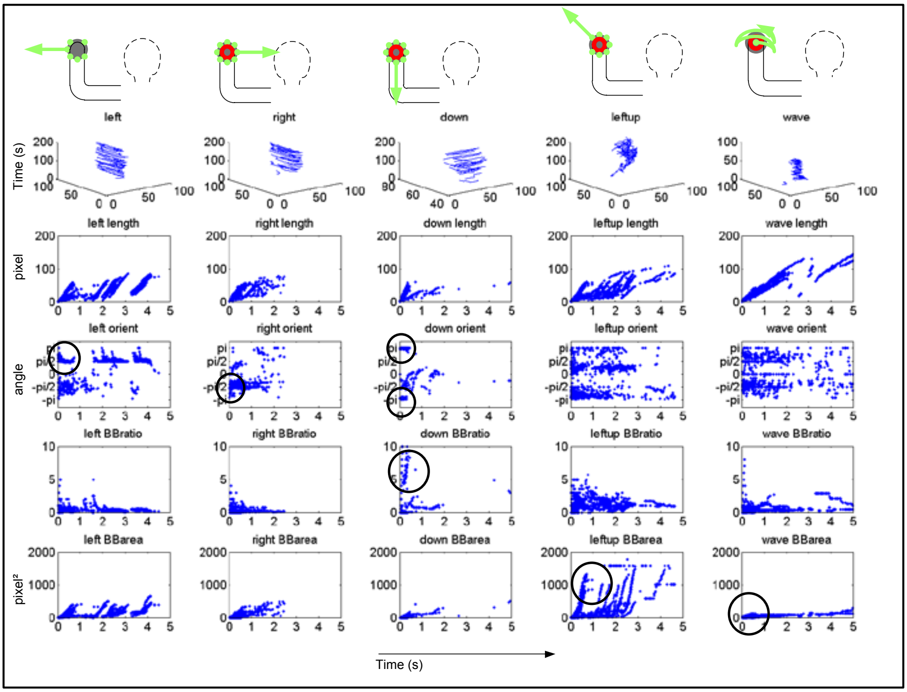

Figure 6. Extracted features for five different gestures. Gesture data are organized in columns in the figure. Original tracks in space-time presentation are shown in the top row axes**.**

Acknowledgements

The FoSIBLE project is funded by the European Ambient Assisted Living (AAL) Joint Program together with BMBF, ANR and FFG. The authors want to thank Jan Bobeth from the Centre for Usability Research and Engineering (CURE) for his valuable input in the menu navigation concept.

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TOUCH GENERATION: ONE-HANDED SINGLE- AND MULTI-TOUCH MENUS FOR THE ELDERLY

Benjamin Wimmer[1], Bernhard Wöckl[1], Ulcay Yildizoglu[1], Manfred Tscheligi[1,2]

Providing an easy to use and accessible interface is one key to success for AAL technologies. However, not only the usability and accessibility of the interface but also the usability and accessibility of the interaction itself needs to be considered. Touch screens are nowadays commonly available for all sorts of devices and have triggered a change from indirect (e.g. mouse and keyboard) to direct interaction paradigms, easing the interaction especially for older users. Since mobile touch devices are emerging and our society is ageing researchers and developers not only have to focus on new services, user experiences and technology acceptance, but also on the limits and restrictions of the older generation.

In our study we investigated the effect of age differences on usability of five mobile device one-handed single- and multi-touch menu types to be operated with different finger orders: thumb/index or index/thumb. Our results show that both elderly and young users benefit from one-handed single-touch interactions operated with thumb/index order. Further, results indicate that single-touch led to better performance and lower error rates than multi-touch. However, older users performed better when using two fingers (thumb and index finger) than with standard single-touch interaction with one finger.

1. Introduction

Recent trends show an increasing number of personal mobile devices using touch interaction as a more intuitive interaction approach. As well as the trend of mobile touch devices, a demographic change in our society can be observed. People are growing older and it is projected that in 2060 30% of the population will be older than 65 years [1]. Therefore, future research will have to investigate not only new application fields, ways and forms of mobile single- and multi-touch interactions, but also age differences have to be addressed to develop successful mobile touch and multi-touch solutions. Moreover, in the near future single-touch seems likely to be

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replaced by multi-touch interaction since it offers advanced opportunities and new user experiences including intuitive natural gestures or novel menu interactions.

Diverse studies in the field of (mobile) touch interaction offer usability or technical guidelines for touch interfaces and interactions 00. Other research has already looked into the accessibility of (mobile) touch gestures comparing young and old users 00. Error types that may occur when old users interact with touch devices were defined by 0 namely: "missing", landing and lifting outside the target bounds; "slipping", landing on the target object but slipping off before releasing; and "missing just below", selecting the very top item that stands below the target.

In our study we compared performance and accuracy measures of different one-handed single and multi-touch menu interactions to be operated with different finger orders between different age groups. Significant differences related to performance (time), type of interaction (single/multi-touch) and finger order (thumb/index; index/thumb) could be found. However, we were surprised that no significant differences related to accuracy (error rate) occurred.

2. Method

Five different single-touch (ST) and multi-touch (MT) menu types to be operated with different finger orders (thumb/index – TI; index/thumb – IT) (see Figure 1) were investigated. During the study, time (performance), error rate (accuracy) and error type were measured.

Participants: Sixteen younger users (8 female, 8 male) mean age M = 24.63 years; SD = 2.19 and sixteen (8 female, 8 male) older users mean age M = 67.75 years; SD = 4.57, participated in the study. All participants were right-handed and without any motor restrictions. All participants were novices in using mobile touch devices.

Prototype: The prototype (Adobe Flash Builder 4) with display size of a mobile device (W: 51.888 mm; H: 77.832 mm) was based on guidelines and previous studies 000. The prototype included five touch menu types (see Figure 1): A. "Classic" single-touch menu for interaction with index finger only (ST). B. Single-touch using first index finger then thumb (ST_IT). C. Single-touch using first thumb then index finger (ST_TI). D. Multi-touch, first placing and holding index finger, then using thumb (MT_IT). E. Multi-touch, first placing and holding thumb, then using index finger (MT_TI). A touch was registered on button release, making drag possible. All menu types included four main categories each with four sub-items (see in Figure 1).

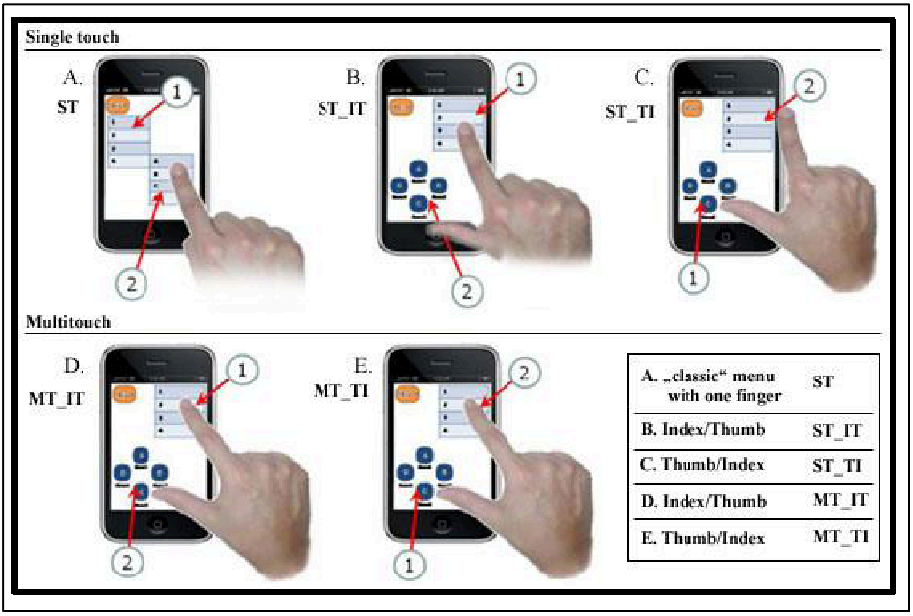

Figure 1: Five touch menu types. Numbers (1, 2) indicate the finger order (TI, IT).

Study: The study was divided into three steps being repeated for each of the five menu types: (1) Training phase to get familiar with the different menus (see Figure 1) using a dummy menu and training tasks. This step was repeated until the participants felt comfortable with the provided five menu types. (2) Introduction of menu categories and sub-items of the evaluation tasks to minimize bias through search time. (3) During the evaluation tasks, as practised for the training tasks, first a sub-item (e.g. Vienna) was presented. When the participant was ready, a start button could be touched to displaying a menu with four categories (e.g. Cloth, Food, Season, City). The task was first to select the right category (e.g. City) and second to select the previously presented sub-item (e.g. Vienna) within a table offering four different suggestions (e.g Vienna, London, Rome, Madrid).

The classical menu (ST) was always evaluated first as this interaction is known from desktop applications, acting as a reference measure. Thereafter, half of the users in each group continued with single touch and the other half with multi-touch menu types. The sequence of used fingers (IT, TI), presented sub-items to be selected and menu categories were randomized and counterbalanced within both age groups. For each of the five menu types each participant had to carry out sixteen evaluation tasks.

In addition, the following three error types were defined for the evaluation study:

- “Miss”: Select the correct category but missing the target sub-item and select one adjacent sub-item instead (possible under ST/MT condition).
- “Drift”: Drifting the finger placed on the correct category onto another, while the attention is on the target sub-item (possible only under MT condition).
- “Miss&Drift”: Drifting from the right category and selecting an adjacent sub-item instead (possible und MT condition).
- “Wrong”: All other occurring errors (possible under ST/MT condition).

3. Results

Results were compared between the users from different age groups.

Performance (time): Results show that the older users were significantly slower than the younger ones over all five menus and finger orders. Moreover, performance rates of both age groups were significantly higher under single-touch than multi-touch conditions. Further, all users revealed higher performances with thumb/index finger order under all menu conditions.

Accuracy (error rate): The accuracy rates of both age groups were very low. Whereas in the younger group errors occurred mainly under multi-touch conditions, older users made errors in both single- and multi-touch interactions.

Accuracy (error type): Younger users only made errors related to the types “Miss” or “Wrong”. Among older users all four different error types could be found.

4. Discussion and Conclusion

The results on performance (time) and accuracy (error rate) measures indicate that both user groups benefit most from single-touch menu types, operated with thumb/index finger order. However, when focusing on error types, the young users did not show the error type “Drift”, whereas the elderly users committed all four defined error types.

These findings on error types indicate some challenges for future interaction research: Are age-related changes responsible for “Drift”, which is only possible in multi-touch menu types? Will multi-touch interaction lose its charm in our ageing society? Or is training (experience) the key for success in using multi-touch interactions for older users? As this study could show, future research on touch and multi-touch interaction addressing the target group of older is necessary to create successful and sustainable AAL technologies.

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MOBILE CONTEXTUAL ASSISTANCE FOR BARRIER FREE MOBILITY OF ELDERLY PEOPLE IN PUBLIC TRANSPORTATION

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Abstract

The project MARIA aims to develop mobile assistance for barrier-free navigation in urban public transportation, targeted at elderly people with problems orientating themselves and understanding standard type guidance information. MARIA is developed as a specific application service for today smartphones and continuously assists the passenger on its way. Intelligent guidance is provided through an on-going computation of geographic and semantic context that enables the service to appropriately react in response to characteristic situations without the need for interaction by the user.

Figure 1. Mobile service for assistance in navigating public transportation.

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1. Introduction

The use of public transportation is an essential prerequisite for barrier-free mobility and from this for long-term integration in social environments. The richness in the information offered in public transportation nowadays may also cause counterproductive consequences with respect to the usability of already existing services. In particular, there often occur problems if the information cannot be perceived and understood appropriately or is presented in a much too complex manner in the case of elderly people with with cognitive impairments.

The Austrian national project MARIA has the following objectives,

- Mobile assistance for elderly people. In contrast to previous highly local supportive systems, MARIA develops a service for continuous assistance and support of elderly passengers, especially in critical situations (selection of traffic lines, navigation, entering and leaving vehicles).
- Information interaction with public transportation infrastructure for the most actual information access. Access to just the actual, most essential information (coach position, delays, etc.) enables efficient and comfortable assistance for the benefit of the passenger.
- Semantic analysis of characteristics of social target group. MARIA enables the analysis of anonymized protocol information (geo-information, interactions, reported data, decisions) and from this a semantic evaluation of ways and objectives of the targeted social group.
- Image-based assistive technology for intelligent access of appropriate information spaces. Information text at bus stops and in trains can represent a challenge and form barriers in acquisition and understanding of complex text. MARIA offers a service for image-based text recognition and automated translation for the better usage of public transportation as well as in everyday situations.
- Iterative integration of social requirements during the entire development process and the associated usability research. MARIA guarantees through its professional treatment of user-specific requirements a fundamental, actual and complete consideration of the elderly social target group within the design and functioning of the technology.

The basis for this technology is mobile phones that are already available on the market, with graphical displays, a camera and innovative image analysis methods. The scenario is to direct the mobile camera to a public transportation sign (bus stop) or a textual region (at the bus stop or within the train) and to receive audiovisual information for assistance, for example, by text to speech or easily understandable graphical instructions. MARIA includes an intuitive assistance for barrier-free use of public transportation. Images of signs or text are analysed, the context associated and the system may start appropriate assistance to support the user.

2. Method

Current passenger information and routing systems are usually accessible via the homepage of the corresponding transportation service provider. This service is only available with standard web browser usage and causes problems because these browsers are not optimized for the mobile phone type display. Furthermore, the performance of web browsers on the mobile is not comparable with their performance on desktop computers, regarding dynamic content and interactivity. These problems have been covered partially with specific software, such as in the Viennese mobile service for public transportation navigation (Qando), offering routing about usage of public transportation, however, intelligent assistance for supporting the user at the navigation points – where the medium of transportation is changed – is not part of it. This is the reason why these kinds of systems are not suitable for barrier-free guidance and impose difficulties for orientation and understanding.

The mobile service MARIA provides a mobile assistance for barrier-free navigation, targeted at elderly people who problems orientating themselves and understanding standard type guidance information, and in this way it contrasts with any other system available at the moment. Intelligent guidance is provided through an on-going computation of geographic and semantic context that enables the service to react appropriately in response to characteristic situations without the need for interaction by the user. Context recognition takes advantage of the multisensory equipment of mobile phones available nowadays, for example, to decide whether the user is taking a stroll in the city or using a tram or bus. Position and acceleration sensing, digital compass and GPS receivers are provided to support the contextual computing unit. A typical example for contextual support is requested at navigation connection points: the unit analyses whether the user enters the targeted tram line or not, and if not, the system can respond appropriately for further support. MARIA is also being developed towards extended usability in terms of the design of the mobile graphic display, which will be in contrast to the de-facto standard. The graphical user interface will be designed according to the requirements defined by the targeted social groups in order to guarantee the most comfortable usability.

The assistive mobile service aims at the implementation of a interface between the user and the MARIA system. The passenger should be enabled to use all functionalities independent of choice of time and location. The key features are as follows:

- **Intuitive user interface**: The user interface provides access to all functionalities via a specific user interface, according to the requirements determined by usability analysis.
- **Intelligent navigation assistant**: Implementation of real-time navigation and bidirectional passenger service. Implementation of userspecific intelligent guidance with appropriate speech output. This will include, on the one hand, consideration of various information sources for the actualization of time plans, information about position and delays.
- **Context recognition** based on multisensory information for the support of navigation. The automated context recognition system is capable of

interpreting movement patterns and from this the behaviour of the mobile user, and finally concludes about the appropriate mobility of the target user. In case of deviations from the planned behaviours, the intuitive interface activates appropriate functionalities in order to alert the user and inform about a targeted compensation behaviour.

- Integration of the navigation assistant with **mobile augmented reality** functionality to overlay the real-time camera image
- **On-board service**. There will be an interface from the mobile service to the bluetooth-based infrastructure within the coach. This service will enable it to utilize information about the status of the coach, such as opened doors or position of the coach within the city map, that support intelligent navigation and interaction with the passenger.

3. Mobile vision service

The project MARIA will initially make use of marketed standard software for text recognition that will be applied in the mobile service for the specific target groups. The user points his camera phone towards a text, such as information by public transportation, snaps a photo and receives in turn the translation of the text using earphones or the loudspeaker of the phone. In case of elderly tourist users who are not using German language we intend to use an automated language translation service. In cooperation with usability research and professional translators with experience with immigrants, we will attain an appropriate mapping from text to a translation of most used phrases. Software that has been used for the identification of medications [1] will become the basis for further research and development in order to develop a robust service. The objective is to develop a service that is operating in real time and in a robust way since text recognition in the real-world outdoors is a challenge. In addition, a mapping between public transportation signs, such as at bus stops, and appropriate information services is considered. The software will be based upon mobile vision services for geo-indexed object recognition in urban environments [2, 3, 4].

The camera phone will act as an "intelligent loupe" for the passenger, including the functionalities of (i) text detection with mobile images, (ii) recognition of general text in images, for the (iii) magnification of recognized text and for (iv) the translation of text in a foreign language into the chosen language of the passenger, and (v) for acoustic presentation of recognized text. Initially, the device will operate in client-server mode. Finally, a client-based service will contain relevant functionalities for computer vision for the rapid interpretation of text at the site. The intelligent loupe represents a central element for the implementation of barrier-free mobility in public transportation and can also be used by passengers for support in everyday life. Development of a robust service is challenging because image-based services are seriously dependent on illumination conditions and thus represents an active field of research.

4. Usability analysis targeted at elderly people's use of mobile services

The key idea behind MARIA is to develop a user-specific service that is in contrast with all existing general purpose public transportation services. In contrast to the "design for all" concept [5, 6, 7] there exists a concept of multimodal interaction that makes use of audio and voice [8, 9], eye movements [10], and mobility [9] or haptic interactions [11] that aims at identifying the various requirements of specific user groups. Multimodal interfaces enable sequential, parallel, independent and combined interactions [12]. Furthermore, the emotional status of the user and his or her reactions can be extracted and classified [13]. In MARIA the focus of usability research is on the investigation and evaluation of user experience factors, with respect to the individual social target group – the elderly – and the routes and methods of transportation that are used by the passengers in natural mobile environments. The results of this investigation directly impact the design and the functionality of the mobile service.

MARIA involves a user-centred design strategy with direct involvement of the user in order to attain universal accessibility, usability and user experience. Focus groups have been investigated together with specific user groups to develop scenarios for the use of the MARIA functionalities. Problems and requirements were protocolled and mapped to a valid support of the technological development process. Living Lab methods (z.B. ESM, Remote Usability Testing) have been investigated that delivered in real-time information about the usage of the system, interactions and user experiences in interaction with a specific system version in the natural environment.

5. Business case focus

The MARIA mobile service assistance technology will be soon applied to already existing mobile services on public transportation in the city of Graz, Austria, and from this it can easily be scaled up from a prototypical research implementation, once it has progressed to an industrial prototype, up to application for really large user groups (hundreds of thousands of users in large cities, such as Vienna or London). The focus on meeting the requirements of the elderly will enable a tight binding of these passengers to the public transportation services which will finally represent a modal shift resulting in more passengers. At the same time, the citizens become more satisfied, can act more in accordance with their true interests, and from this communication and investment will be intensified in the urban environments.

6. Conclusion

There is a wealth of products that are specifically suited to elderly people, such as the Nokia Emporia phone. For the development of these technologies, the cognition and the physical constraints of elderly people should be considered in both design and functionality. However, in contrast to the sensibility exhibited for problems and requirements, the use of technical equipment still remains a grand challenge to elderly people. Most importantly, the inclusion of elderly people into the design process is a major issue in order to guarantee improvement of their quality of life. The relevance of MARIA is to develop a continuous service for assistance which is a major concern for support of the perception of the environment and the mobility of elderly people.

Acknowledgments

This work is part of the project MARIA and has been partly funded by the Austrian Federal Ministry for Transport, Innovation and Technology and the Austrian Research Promotion Agency (FFG) under contract number 825228.

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AMBIENT INTELLIGENCE TO EASE ACCESS BY SENIORS TO ICT-BASED SELF-SERVICES

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Abstract

Many innovative and advanced solutions are conceived to provide assistive services to seniors. In many cases, such solutions do not pay the necessary attention to aspects such as accessibility and adaptability, putting an unaffordable limitation on elderly people who are generally not very familiar with technological devices. This paper presents SAAPHO, a system aiming to solve the limitations experienced by seniors when interacting with assistive technologies. SAAPHO uses Ambient Intelligence technologies able to assist users when interacting with assistive technological frameworks. By adapting and customizing the interfaces to their specific needs, SAAPHO provides the users with access to a wide set of services, generating a simpler and more easy-to-use framework for assistive technologies.

Keywords: Ambient Assisted Living, Accessibility, Human-centric Interface Design, Ambient Intelligence.

1. Introduction

The modern European society is committed to take care of its citizens. Nevertheless, ageing puts a strain on the well-being, independence and dignity of people's life, making it difficult to guarantee the feasibility of this commitment. A significant percentage of people living in the European community are currently over the age of fifty and this trend will to rise in the next twenty-five years [1]. These changes in demographics will have a clear effect on the society where we live and will pose a major challenge for citizens and governments. The use of assistive technology in health and social care is still rather limited and its use is not always considered as part of the routine assessments or clinical procedures. The impact of the emerging technologies and modern computational devices are frequently dissipated and not completely captured by staff, partners, users, patients and care-givers. Nevertheless, the demand for introducing technology to improve the quality of life of older people is progressively increasing because of the high impact it might have [2, 3]. In particular,

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Ambient Intelligence has introduced a new source of potential applications and services with a promising impact on assistive technologies. Although Ambient Intelligence is generally related to home automation or control of ubiquitous environments [11], it promises to play an important role in assistive technologies. In particular, context-awareness represents the features of Ambient Intelligence system, able to provide major benefits in terms of assistance to the users. Context-awareness refers to the recognition of situations and acting according to the level of assistance required.

This paper presents SAAPHO (AAL-2010-3), an on-going European project now in its first year, funded by the AAL programme. SAAPHO seeks to stimulate and incite participation and e-Inclusion of elderly people in the self-serve society by preserving their own life-style and making everyday life easy and safe. This goal is going to be achieved through the use of novel ICT frameworks aligned to the Active Ageing policy [4], with services related to health-care, participation and security.

Ambient Intelligence, the baseline technology in SAAPHO, is responsible for providing an intelligent interaction with the environment by executing commands that users receive from an adaptive and user-customizable interface and providing, at the same time, personalized support and ad-hoc reminders to the user. The adaptation and personalization is performed according to the user's preferences, habits and health profile. In addition, an unobtrusive network of pervasive devices acts to avoid, signal and manage emergencies, preserving security and comfort. Thanks to context-awareness, specific situations are recognized and suitable responses are performed. Conscious of the difficulties seniors face in the use of new technologies [5], accessibility and usability represent the major aspect for SAAPHO to take into account. SAAPHO includes tactile screens as user interfaces to access functionalities. Adapted visual inputs and touching capabilities represent a more intuitive form of human computer interaction for seniors.

This paper is structured as follows. Section 2 provides an overview of related works. In Section 3 an overview on the SAAPHO project and its guidelines will be presented. In Section 4, the system architecture and the role of Ambient Intelligence in SAAPHO are introduced. Section 5 presents early results obtained on a simulated scenario and finally, in Section 6, we conclude the paper with some highlights of ongoing and future works.

2. Related works

Many works in literature stress the fact that ICT solutions must take an important role in enhancing the independent living of elderly people at home, providing at the same time the safety and care of users.

Miskelly [5] provides a comprehensive list of equipment and sensors which will provide an important contribution to the care of older people. Assistive technologies using unobtrusive sensors in the home have to be used to collect lifestyle pattern data.

The lifestyle patterns are regularly analysed and a profile of the main activities of the user is modelled. If the significant deviation from the normal patterns is detected, a telephone message is automatically delivered to the carer.

Robles and Kim [6] give a review of services in the 'smart home' development, highlighting the benefits that ICT solutions promise for the elderly people's independent living. In particular, emphasis is given to the fact that Artificial Intelligence techniques provide a really significant improvement to home-based assistive technologies, especially when compared with traditional assistive technologies. Three main scenarios are highlighted related to fire protection, resident access control and protection of homeowners. In all the cases, authors show that the joint effort of unobtrusive sensors and intelligent algorithms works to significantly improve the quality of life and ensure the safety of homeowners.

From a more practical point of view, there exist a wide range of projects addressing the need for independent living under the active ageing framework that also address the need for safety and security of final users when AmI technologies are applied.

The MonAmI project [10], founded by the EU Sixth Framework Programme, demonstrates that accessible and useful services for elderly and disabled persons living at home can be delivered in mainstream systems and platforms. The main innovation of the MonAmI project lies in demonstrating how a complex mix of technologies, many of them so far only validated under laboratory conditions, can be brought together in a socially and economically viable way to facilitate inclusive access for elderly and disabled citizens. In this sense, SAAPHO pretends the same, adding at the same time intelligent adaptation and user- personalization to the whole system.

On the same guidelines, Netcarity [11], a European project following the Active Ageing guidelines, investigates how new and existing technologies can be integrated cost effectively into people's homes. It aims to develop a new technology infrastructure for homes, with systems that enhance communication with friends, family and care givers but especially support everyday living and promote a sense of social inclusion. The project seeks to encourage older people to live independently and to be more socially active, avoiding the expense and trauma of moving into a care home. Like Netcarity, SAAPHO aims to create a supportive environment at home, adding moreover intelligent pro-activity and facilitation in the interfaces involved in the user-computer interaction.

3. The SAAPHO Project

SAAPHO aims to assist senior citizens in order to support their inclusion and participation in the self-serve society, preserving and enhancing at the same time their independence and dignity through the application of innovative ICT-based solutions. Aligned with the Active Ageing policy, SAAPHO organizes its services along the three main axes of social participation, home security and healthcare. Participation services aim to empower social inclusion by means of communication services especially adapted to seniors. Security services ensure safety and well-being using ambient sensors (gas leak, CO escape, fire, etc.) and monitoring ambient parameters (temperature, humidity, etc.). Healthcare services want to support seniors in following their daily medical routines ensuring their health condition with good habits and best practices.

3.1 A new approach in assistive technologies

Senior citizens might inevitably face some difficulties when adopting new technologies. In SAAPHO, the user experience plays an essential role within the system. Hence, user interfaces are key-points for the control of the whole solution and the interaction between users and systems. Health and user profile are taken into account during the process of interface adaption. Ambient Intelligence focuses on providing a context-aware environment by adding intelligence to our surroundings, providing support for assistive purposes. The main goal of Ambient Intelligence is aiding and facilitating the living conditions of people by improving the way the environment helps us, which creates the so-called assistive environment.

3.2 Senior Adapted User Interfaces

Touch technologies are the main interfaces in SAAPHO. Users interact with content on-screen by touching and gestures, without using mouse or keyboards, providing in this way feedback and command to the system in the form of intuitive and simple interactions. NFC phones represent an important aspect in SAAPHO, too. NFC phones enable a number of self-service functions. The solution proposes a system where a resident in her home can initiate the transfer of information by touching a NFCenabled mobile phone against tags placed in the home on various assets, devices, appliances and pictures.

3.3 User Centred Design

User Centred design will be mainly translated into the study of usability and accessibility of the systems implemented for ensuring its usefulness in the early stages of the project. The SAAPHO project includes a validation period. Over nine months, end-users with different profiles, based in Spain and Slovenia. will be involved in the pilot test phase.

4. The architecture of the SAAPHO system

SAAPHO is designed with a modular architecture that has its centrality in the Ambient Intelligence functionality. In Figure 1, a block diagram of the modules composing the system is shown. The architecture is composed by two mayor modules, the *User Interface (UI) Generator* and *Ambient Intelligence (AmI) Engine*. Communication paths are represented by arrows.

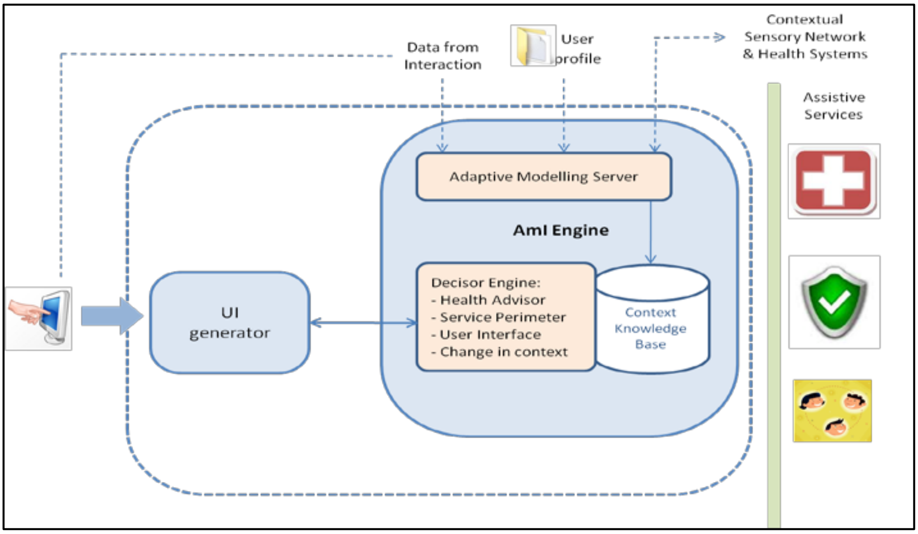

Figure 1. SAAPHO centralized architecture consisting of two main modules: AmI Engine and UI generator with access to three differentiated services**.**

The UI Generator is the module responsible for translating the user's command in order to be understood by the AmI Engine. At the same time, the UI Generator contains all the programming logic able to provide adaptive and user-customizable arrangement of the interfaces. When received, the user's selections are sent to the AmI Engine that represents the intelligent core of the system. The AmI Engine is composed of the *Adaptive Modelling Server*, the *Decisor Engine* and the *Context Knowledge Base*. The *Adaptive Modelling Server* obtains information about the environment. This information, jointly with the user's selections, will provide the final decision about the recognition of the specified context occurring in a specific instant. Moreover, the Adaptive Modelling Server learns patterns related to the user profile. The *Context Knowledge Base* is devoted to storing all the information related to the context and the user profiling like, for instance, interactions preferences and health profile. Finally, the *Decisor Engine* provides the intelligent adaptive core of the system, able to establish, according to the current context, which interface and option list to present to the user. Using the proper interface with the most probable options the user might select, allows the user to save time on navigating through the usual hierarchical menus used in tactile environments. The Decisor Engine is the central part of the assistive environment. It provides feedback and sends communication to the user, signalizing potential dangerous situations and highlighting reminders.

4.1 The Ambient Intelligence Engine

The context, as a source of data, provides valuable information about the potential choices and actions the user intends to do. Indeed, the facilitation provided by the context enhances the user's experience when interacting with the novel technological assets. In the AmI Engine, context is represented by any information that can be used to characterize the situation of an entity [7]. In SAAPHO, context is represented by a list of descriptors gathered via environmental sensors and by the current time with, in addition, the status of the services. This situation is represented in Figure 2.

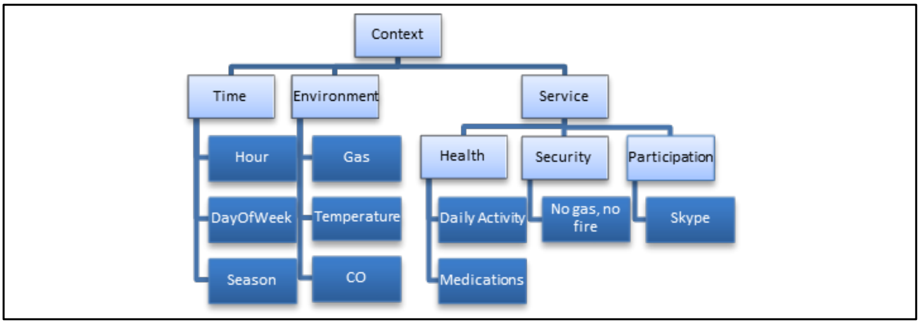

Figure 2. Representation of the context in SAAPHO

The use of context defined in this way allows the use an effective learning approach. The Naive Bayes classifier [8] is a learning algorithm able to estimate the probabilities of occurrence of events after a training period. In SAAPHO, the Naive Bayes classifier is used to obtain an estimation of the probability *P(A|Context)*, where *A* is a selection made the user and $Context = \{X_1, X_2, X_3 \ldots X_n\}$ are the context descriptors. The value of *P(A|Context)* represents the probability that the option *A* is present in the configurable interface, once the context is known and provided. This probability can be estimated using the Bayes rule as shown in Equation 1, assuming that all the variables defining the context have statistical independence between them.

$$P(A|X_1,X_2,X_3 \ldots X_n) = P(A)\, P(X_1|A)\, P(X_2|A) \ldots P(X_n|A)\, Z \qquad \textbf{(Eq. 1)}$$

In the equation, *P(A)* and $P(X_i|A)$, with i=[1,..,n], represent respectively the general probability that option *A* had to appear in the interface, and the likelihood that *A* could appear during that context. Both values are calculated during training. *Z* is a normalization factor. Training occurs automatically and is personalized for the user by means of the continuous use of the SAAPHO system. All commands are routed through the AmI Engine which keeps a record of the statistics of the context with histograms. In this way, the system is able to learn and capture patterns emerging from the user's personal habits.

5. Results of a simulated scenario

A statistical simulation of a basic scenario has been performed in order to validate the presented approach at this early stage. Training data have been obtained by simulating a scenario where healthcare, security and participation services are presented. The services simulated are the following:

- Remind to call Familiars (RF)
- Remind to perform Daily Activity (RDA)
- Remind to take Medication (RM).

The AmI Engine would learn these reminders from the user time statistics. This time statistics have been simulated, on the base of a basic scenario, with variation depending on a predefined mean value and standard deviation.

The validation has been realized on training periods of 15, 30, 60 and 180 days. The time statistics obtained in these periods have been used to train the Naive Bayes classifier. The classifier has been tested on a testing period of 30 days, temporally subsequent to training. The accuracy of the prediction is reported in Table 1.

Table 1. Prediction accuracy on active elements states

Training Days / Service	RF	RDA	RM
15	85.5%	81.1%	92.2%
30	88.3%	91.1%	97.2%
60	86.6%	87.7%	96.1%
180	86.6%	91.1%	96.1%

The results obtained show that after a training period, predictions are sufficiently accurate and they do not necessarily improve as more training is provided. The Bayesian approach is able to learn the probability distribution underlying the training data even when the only information related to the time statistics of the user is used for modelling the context. The results obtained have to be interpreted as the probability that, in the adaptive tactile interface, at the specific time the particular context arises, the user had the reminder to perform the specific activity.

6. Conclusions and future work

This paper presents SAAPHO (AAL-2010-3), an on-going European project that aims to stimulate and incite participation and e-inclusion of elderly people. SAAPHO uses a novel ICT framework providing services related to health-care, participation and security. The central technology in SAAPHO is Ambient Intelligence, responsible for providing intelligent interaction with the environment by executing commands that users receive from an adaptive and user-customizable interface. The Ambient Intelligence functionality also provides personalized support and ad-hoc reminders to user. In SAAPHO, the adaptation and personalization is performed according to users' habits and profiles. The context-awareness capability of the system is able to recognize specific situations performing suitable responses for the users. Accessibility and usability for seniors are the major aspect SAAPHO takes into account. Tactile screens as user interfaces will be used to access the SAAPHO functionalities. Adapted visual inputs and touching capabilities represent a more intuitive form of human computer interaction for seniors.

Ambient Intelligence plays a fundamental role in the development of the SAAPHO system although many technological issues naturally arise in the preliminary part of the development of the system. Nevertheless, the ambitious objective of the SAAPHO project provides the integration and implementation of many different services for each one of the lines the Active Ageing policy provides, providing a really multi-functional assistive pro-active environment.

The SAAPHO project is now in its early stage where a first integration of technologies to satisfy user requirements is taking place. The validation of the ideas in a real environment requires additional development, implementation, and testing, where elderly people will have a predominant role. The SAAPHO project plans to study and assess different communities and institutions in order to obtain valuable feedback from the real end-users.

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WAYFIS: PERSONALIZED WAY FINDING SERVICE FOR SENIORS

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Abstract

The WayFiS project aims at improving the capability of elderly people to plan and execute transportation projects by solving the problems they face when trying to move in unfamiliar outdoor environments. WayFiS is the first route planning service for elderly people that considers both pedestrian and public transportation mobility issues and that it is based on the existence of a wide range of personalization features, building up user profiles, and that include the health state of the person and his or her common behaviours and needs. The target group of the project constitutes elderly people. older than 70 years, and not familiar with ICT or with technology in general, usually living alone and suffering from health limitations due to ageing. The resulting WayFiS services will be tested on target groups in Spain, Hungary and possibly Switzerland. In this paper, the objectives of the project are highlighted and the current state of research activities will be presented.

Keywords: Personalized Navigation Service, Geo-localization, Route planning for elderly, Way finding, User Profiles.

1. Introduction

The European WayFiS project (2011–2103) [1] launched in the Ambient Assisted Living programme aims to improve the capability of elderly people to plan, manage and execute travel and transportation projects at their own discretion by solving the problems they face when trying to move in unfamiliar indoor and outdoor environments, thus enabling them to take part in the self-serve society. The problems

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that are approached are mainly related to access to information, sight problems, walking and/or motor abilities, cognitive abilities, associated health limitations, scarce availability of proper information regarding transport adaptations, accessibility of stations/stops, and so on. The target group of the project constitutes elderly people who are older than 70 years and not familiar with ICT or with technology in general, usually living alone and suffering from health limitations due to ageing. The resulting WayFiS services will be tested on target groups in Spain, Hungary and possibly Switzerland. A key factor of WayFiS is the end users' involvement in all the phases of the project from the project definition to the final user acceptance tests. In this way we aim to cover and adapt the WayFiS service to their needs.

The innovation of WayFiS is the development of a personalized way finding service for elderly people, considering both public transport and paths by foot. It is focused on the objective of making the elderly feel healthy, well and safe. It takes into account their specific limitations and healthy habits, with the challenge of aggregating a huge amount of information from different sources and including them into one mobile service with an intuitive interface (e.g., voice-touch-write). WayFiS is the first route planning service for elderly people that considers both the pedestrian and public transportation mobility issues and that is based on a wide range of personalization features, building up user profiles that include the state of health of the person and his or her common behaviours and needs. WayFiS also includes localization and positioning features for both indoor and outdoor environments that will guide the user along complex paths.

The process of way finding will have to consider a variety of objectives regarding the totality of the journey such as the following: performing the minimum physical activity; matching nutrition needs and disease restrictions; avoiding inaccessible routes; finding necessary facilities along the route.

In order to accomplish these goals the following set of information has to be available: presence or lack of stairs/elevators; availability of public transportation that is enabled for disabled persons (e.g. low-step buses); availability of proper food sources such as markets, restaurants (according to the need of allergy-free or diet-compliant foods); air quality and UV level; pharmacies that provide certain medications in case they are needed urgently; availability of toilets.

Hence, WayFiS will affect the quality of life of elderly people at different levels: it will allow them to maintain mobility, which is a crucial issue for enabling independent and healthy living; it will also guarantee orientation, which is essential for safe moving around in an unknown environment. It will also enable independent living by allowing elderly people to maintain a high degree of independence and autonomy; it will help elderly people to participate in the digital self-service society.

2. Architecture

The product developed by the WayFiS project will be constituted by a mobile interactive end-user application, delivered as a service for elderly people that has been designed to be used with minimum intrusiveness and maximum benefit for them. The service will be available as a twofold facility: a web-based pre-planning application and a mobile application. WayFiS as web-based application will allow end users to test the service and to perform the definition of the user profiles together with pre-planning of the desired journey. This facility will be provided as web-based application and not as standalone software in order to avoid the final user from having to install the program on his or her computer. The WayFiS service will then be available as smartphone application to allow the user to be able to view in real time his current location and the path to be followed on his portable device and also to hear the directions by a voice describing the journey. In Figure 1 the WayFiS Pilot scheme is provided.

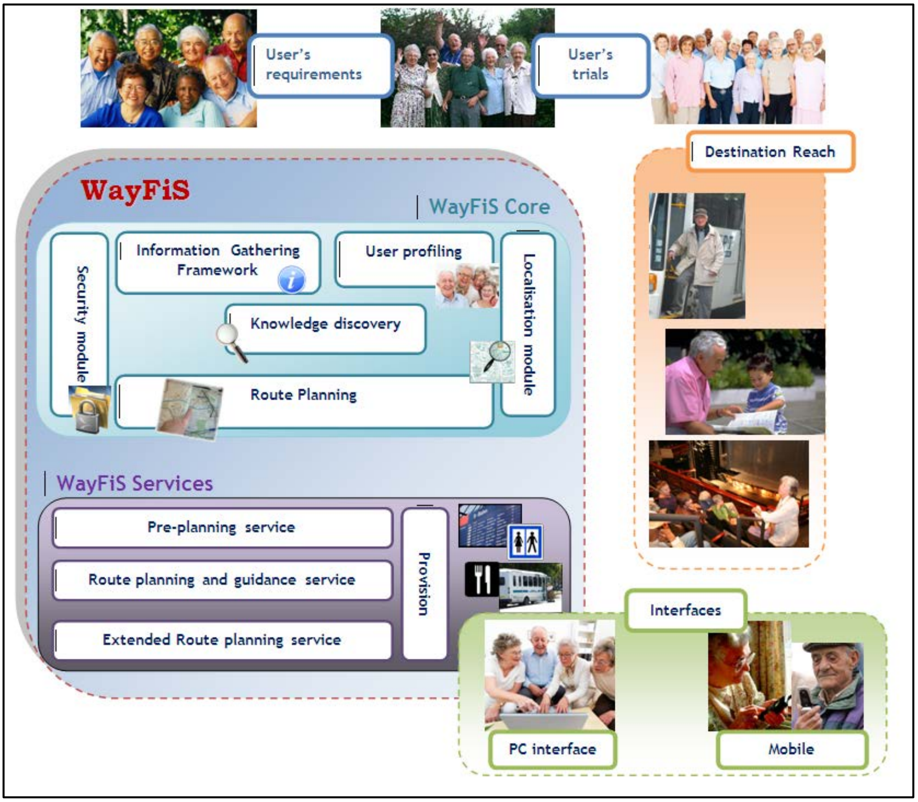

Figure 1. WayFiS Pilot scheme

The core technologies of WayFiS are the following: a knowledge discovery module and information gathering framework for processing and integrating the huge amount of heterogeneous information from multiple sources, including traffic information, travel time prediction, stations/stops accessibilities, surrounding characterization; a user profiling module for building up profile characterizations associated to the route information for textual-based agents; a localization and positioning module with the use of outdoor technologies like GPS or triangulation of network-signal based localization and indoors technologies like navigation supported by stationary bacons from Wi-Fi, Bluetooth or RFID technologies, or combination of those; a route planning module including context-aware technologies and route optimization; a privacy and data security module for personal data protection. Thanks to these technologies, the following services will be provided to the elderly: web-based pre-planning service; route planning and guidance service.

The interface should be designed for elderly and disabled people. This implies that problems like vision, technology understanding, manual dexterity,etc. must be taken intp account. The interface must follow a general design rule for all the common elements such as how to scroll the view, colours and fonts used, the symbols and figure used, pollution of interface elements (i.e. buttons, text inputs, and etc.), the size of the elements, and the use of specific hardware buttons present on the mobile device.

3. Validation phase

The WayFiS project will be based on the development of a pilot to be tested by end-users in Spain and Hungary (thanks to the presence of end-user organizations that are partners of the project): in this way, a wide test bed covering different ages, interests, needs and cultures is provided.

Namely, based on measurements-based performance evaluation methods, we will quantify the service speed, accuracy, dependability and scalability for a real-time, continuous navigation of seniors in real-life environments. Moreover, we will employ evaluation methods from the human-computer interaction domain in order to evaluate usability, interface design and effectiveness of service interactions on mobile devices. These methods will be employed at least in two stages, i.e., involving first young and healthy student volunteers to get their initial feedback, and then the target end-users at the later stage of the system development.

Most of the targeted end users of the system are not familiar with mobile technology and web applications. The majority of them have never tried to use a device such as a smartphone. The user acceptance of the system can be strictly related to the acceptance of the mobile device that will be used. If the user does not want to explore the new technologies, the evaluation of our system will be compromised by scepticism on the use of mobile devices such as a smartphone. Therefore it is really important that the end users involved in the evaluation phase are willing to try new technologies and have basic knowledge of ‘computer systems’.

4. Market analysis phase

Currently, market analysis research is being performed which aims at identifying the navigation solutions that are already available in the market and to compare them with the WayFiS solution.

Several mobile navigation solutions for pedestrian paths are available on the market. One of them is Navigon [2], which offers a large navigation system with a lot of intelligent pedestrian mode features. However, it is not adapted for elderly users since it does not take care about the physical abilities of the user, it does not offer a web-based planning tool and it does not offer data adaptation on the basis of the user's interests such as filtering of the points of interest (POI) specified by the users. Nokia Maps [3] offers voice-guided navigation for pedestrians and drivers in 74 countries and currently has 27 million users. However, as in the previous case, it focuses on generic pedestrians not elderly ones in particular.

Google [4] is currently only providing a beta version of a pedestrian mode, which is directly integrated in Google Maps; however, this is not software specifically dedicated to pedestrians so that it is very far from being suitable for use by elderly people for pedestrian mode.

FoxyTour [5] is a guide that adapts automatically to its user thanks to trust engines. It is a collaborative smartphone application allowing its users to post virtual tags to describe a monument, a restaurant or any geo-related feature. Users can also add subjective comments to it. This information is then used by the trust engines in order to determine how a given tag is relevant for a given person in a given context. A tag can also contain a tour attached to it. In that sense, FoxyTour can be considered as navigation software. FoxyTour and WayFiS share certain features, among them: both are navigation tools that adapt to their user; both have a web-based interface. However, some differences mean that FoxyTour is not adapted for elderly users: FoxyTour is a collaborative system whereas WayFiS must work optimally even when there is no collaboration from the users; and there is a complicated user interface since FoxyTour is designed for technology-aware people so that it is not the target segment of WayFiS.

From the market analysis phase we have seen that WayFiS seems to have a good chance of being the first commercial navigation tool specifically designed for elderly people. Despite our intensive search, no similar commercial product has been found.
This analysis has also concerned research on the state of the art regarding European projects that are focused on personalized navigation tools.

OASIS (Open architecture for Accessible Services Integration and Standardization) [6] is a currently ongoing project aimed at developing services and applications with several functions such as nutritional advisor, activity coach, brain training, social community platform and health monitoring. Similarly, WayFiS provides independent living applications and autonomous mobility services mainly for outdoors activity helping senior citizens to find their way. MyITS (Personalized Intelligent Mobility

Service) [7] intends to facilitate mobility of target groups such as the elderly or families with small children, adapting mobility services to their specific needs. INTIME (Intelligent and efficient Travel Management for European cities Project) [8] uses Real Time Traffic and Travel Information (RTTI) services to provide information to drivers and travellers in order to reduce pollution, traffic congestion, energy consumption and at the end, to stimulate public transport usage. AENEAS (Attaining Energy-efficient Mobility in an Ageing Society) [9] aims at improving the attractiveness of sustainable transport and contributing to the use of energy-efficient modes of transport among older people. The Autonomie Project [10] tries to facilitate indoor and outdoor mobility for visually impaired people, using advanced technology tools. As in WayFiS, the Autonomie Project deals with mobility (in this case, of visually impaired people) but what WayFiS contributes is mobility using public transport and specially adapted to the elderly, which is very important to enable easy and economic access to anywhere the elderly person wants to go. WayFiS and Autonomie could be complementary projects.

5. User requirements phase

At this stage of the project the user requirements phase is being developed. The objective of this task is to collect the requirements from the end-users, defining the main characteristics of the services, usability requirements, and main functionalities. In this task user assessment methods are being applied, which include general surveys, focus groups and semi-structured interviews in which both quantitative and qualitative approaches will be taken into account. The results will feed directly into subsequent work packages to ensure the strong user-centred focus of the project. In addition, the task will examine what conditions influence the acceptance of the technology and therefore are necessary preconditions for adoption.

The preliminary results of this task reflected some significant real needs of potential users. These requirements range from health-related needs like the necessity of a health monitoring system, need of the functionality of reminder to take medicines, the availability of pharmacies or hospitals. Moreover, some interesting requirements have been expressed by the end-users, which were not initially foreseen, that are related to the safety of the elderly such as, for example, the notification of easy paths along the way or the presence of alert systems for relatives in case of need.

Other interesting suggestions come from the needs the end users have expressed concerning their social life, such as the availability of POI depending on the user's profile such as senior citizens' centres. As far as transportation related needs are concerned, end users express the necessity of some functionality for finding nearby public transportation stops and for an easy to use route planner.

In parallel to this task is also taking place the implementation of an Ethical and Social Impact Study covering the main normatives and recommendations that should be considered in a project involving senior citizens as end users.

6. Future activities

The future activities that will be undertaken during the forthcoming phases of the project are mainly the technical specifications and then the implementation phase. In fact, from the results of market analysis and user requirements, the specification of the services will be performed. The objective will be the implementation of the WayFiS prototype: first the core system will be developed and the implementation of interactive services will follow. The core of the prototype will be implemented by means of different modules covering the main functionalities and characteristics of the product. Once the different modules are ready, the next step will be the implementation of incremental services: basic service, extended service, and pre-planning service (web-service). We will also consider mobile and PC user friendly interfaces and another important issue that will be deeply investigated will be the service provision in order to identify the most suitable way to provide the service to the elderly users. After these different developments, the WayFiS prototype will be ready to test, after the corresponding technical validation. Thanks to the easy provision method to be implemented, the trial site does not need a specific trial environment development. The trial sites will be divided between Hungary and Spain with end-users representing different age groups, different geographical locations and different socio-economic groups in central and western Europe. WayFiS test environments are realistic user environments, whereby WayFiS will be tested on the users' daily activities and not limited to a controlled environment in order to demonstrate the success criteria of the proposal. The outcome of the tests will be monitored and investigated, both in situ and based on surveys and interviews with the end users.

Acknowledgements

WayFiS is a project funded under the Ambient Assisted Living Joint Programme (AAL JP) on the third call AAL-2010-3.

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CLOSING THE LOOP IN AMBIENT ASSISTED LIVING THROUGH INTERACTIVE FEEDBACK

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Abstract

Supporting positive health and wellbeing is a critical challenge as changing demographics will result in an ageing population. 'Aware homes' have the potential to support older adults in their place of choice as they age, with the ability to detect a wealth of information regarding their functional, cognitive, social and emotional wellbeing. Our research aims to create a new method of preventative care based on early prediction of changes in emotional state and, based on this early detection, we use novel 'human-in-the-loop' intervention methods specific to the needs of the individual to improve the quality of life of the older person *before* severe problems arise. In this paper we describe our ongoing research in this space, highlighting the importance of a closed feedback loop to support an older person in living independently.

1. Introduction

Population projections estimate a significant increase in the number of older adults in the near future [1]. By 2050 an estimated 22% of the world's population – nearly 2 billion people – will be aged 60 or over [2]. Thus, improving the period of health ageing, by enabling older adults to maintain an active role in society and to manage their own health in the place of their choice, is an essential and pressing need, and technology can play a significant part in this [3], [4]. 'Aware homes' support the monitoring of older adults, with the potential to detect a wealth of information regarding the resident's functional, cognitive, social and emotional wellbeing. A crucial part of the research into monitoring in aware homes involves the devices and sensors that are required to capture wellness data, the analysis of data gathered from such devices and the detection of patterns of behaviour, or more importantly, deviations from normal behaviour. Indeed, research in the critical domain of ICT for ageing (including telecare and telehealth) continues to focus almost exclusively on these issues with the rare exception exploring techniques of feedback to clinicians or carers [5]. As such, an issue requiring further examination in this space is what happens to this data once it has been processed. How do we feed this information back to people and to whom do we feed it back?

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Within the CASALA research centre we are very well placed to carry out such research, through our Living Lab[2] at Great Northern Haven (GNH), located in Dundalk in the north-east of Ireland. GNH is a demonstration housing project consisting of sixteen purpose-built homes, each equipped with a combination of sensor and interactive technology to support ambient assisted living (AAL) for older adults. There are a total of 2240 sensors and actuators throughout the development, with approximately 100 sensors embedded within each home. The sensors include PIR sensors to detect motion; a number of window and door sensors to detect and report opening and closing, and sensors to detect power consumption and heating usage. In addition each home has a number of alarm cords and buttons, a home security system and a telecare device that links with a monitoring service. To date, we have collected a vast amount of data from the embedded sensors and models are being built to detect patterns in activities of daily living and health. GNH is a unique development in that it is not a test bed for research. These are real people's homes and as such, the data we are collecting is extremely rich. We work very closely with GNH residents in determining their needs. They are not research volunteers, as is the case with most research projects, and this provides us with a unique setup. Furthermore, the residents represent a diverse cohort, ranging in age from early 60s to late 80s, representing varying levels of computer use and interest, and each with varying health conditions.

Our research aims to create a new method of preventative care based on early prediction of changes in a person's state and, based on this early detection, use novel 'human-in-the-loop' intervention methods specific to the needs of the individual to improve the quality of life of the older person before severe problems arise. What is important, critical even, is how the technology can communicate our findings, allowing the individual to play a greater role in actively managing their health and supporting them in changing behaviours to improve their wellbeing. This will ultimately help older adults to live independently in the place of their choice for longer. To this end, we have installed two interactive devices into each home, to deliver feedback gathered from both the sensors and self-monitoring to residents. These are an Internet-ready television and an iPad2. The aim of both devices is to deliver services to older adults through a series of applications, which can include anything from local services, cognitive games and social applications to the delivery of health-related information, through accessible and intuitive interfaces.

While our previous work has discussed the interpretation of data from embedded sensors at GNH [6], in this paper we provide an overview of our person-centred design research at GNH. We describe some of our work to date in designing and delivering monitoring and feedback applications to older adults through interactive devices.

[2] http://www.casala.ie/casala-living-lab.html

2. Methods

Monitoring

At GNH, residents are currently monitored through embedded sensors in the home [6]. As a result of research carried out with the residents to explore issues around self-management of health [7], we are also currently designing an iPad application that will allow residents to self-report on their wellbeing. While the residents felt a level of security with the sensor monitoring being in place, they also expressed a wish to be able to report, themselves, on their health. The 'daily health survey' asks the resident a short list of questions each day about their emotional wellbeing, the quality of their social interactions, quality of sleep as well as a trivia question (Figure 1). The daily health survey will also collect physiological measures including weight and blood pressure. Gathering regular input from the person on how they are feeling day to day has the potential to 'fill in the gaps' that might occur with sensor-only measurement and help researchers to determine 'why' certain changes might be occurring.

In designing the daily health survey and feedback mechanisms we are working closely with GNH residents, and other older adults in the community, through focus groups and interviews, to pilot questionnaires, evaluate preferences for feedback visualizations and evaluate technology usability. For example, we piloted the acceptability of a validated short form of PANAS [8] with older adults, to determine how they feel about answering questions relating to emotional wellbeing. This questionnaire asks how the person is feeling across ten items, five relating to positive wellbeing and five relating to negative wellbeing. The majority of older adults in our focus groups highlighted that they felt one of the items 'Please choose how *upset* you feel today' could potentially cause stress for the person answering the question as it might bring issues to mind that cause the person to become upset. It was also felt that if there wasn't support in place to deal with this potential problem at the time of answering the question, then it should not be asked.

Figure 1. A question from the daily health survey, delivered through an iPad application

We also worked with older adults in designing how the health survey application, seen in Figure 1, would look. We presented focus group participants with a number of different methods for inputting how they were feeling, for example 'smileys', word clouds, the self-assessment manikin. However, the majority of focus group participants preferred simple text.

Feedback through applications

We are interested in delivering two types of feedback to GNH residents through their interactive devices – firstly, informative feedback which simply shows the resident the data that has been collected regarding their wellbeing, and secondly interventions, which might include lay interventions as well as clinical. In working with older adults in the design of feedback, it was generally agreed that any feedback should be clear, obvious and easy to interpret. For example, graphs, such as that displayed in Figure 2, were considered easy to understand and were generally preferred over other types of visualizations such as a garden metaphor where a garden is in fuller bloom when the individual is doing well health-wise. Any cartoon-like visualizations, such as an avatar 'health coach' were considered inappropriate and too child-like for delivering health related information.

Figure 2. Sample graph depicting changes in a person's weight over time, delivered through an iPad application

As an aside to health and wellbeing applications, there are a number of other applications of interest to older adults, in particular home security. Currently GNH residents have a touch-sensitive always-on device in their home, which we call ALAN – Assisted Living Access Network – that shows whether a door or window is open or closed, whether the stove has been left on and whether there is a leak somewhere. In response to a request from the residents, there is also a widget showing the current weather. The device provides a sense of security to the residents regarding the status of their home – a quick glance at the device as they leave the house or go to bed provides peace of mind that their home is secure.

Figure 3. ALAN – Assisted Living Access Network – showing current weather and home security. A red icon means a door/window is open or the stove is on

Usage and usability of interactive devices

To date, residents at GNH have been interacting with the internet television and iPad in their home for 'fun' activities, with the idea being to allow residents to become accustomed to the technology before expecting them to use these devices in managing their health. Simply having access to the Internet has made a huge difference in the lives of the residents. The iPad has provided access to Skype, allowing residents to keep in touch with family members and friends. YouTube has also proved very popular, particularly for searching for favourite songs.

The majority of residents are engaging well with the technology in their home, in particular the iPad. The residents partake in a weekly iPad class to ensure they get the most out of their device. Running this class has provided us with invaluable insight into the issues that arise in introducing technology to older adults. For example, while the residents find the iPad easy to use and navigate, it was more difficult to teach concepts such as the internet and Skype to people who are completely new to this type of technology. However, overall the technology has been welcomed and we do not expect it to be a barrier to assisting the residents in managing their health.

3. Conclusion and future work

To date, we have been monitoring behaviour at GNH through embedded sensors in the home, whilst at the same time introducing the residents to interactive technology, ensuring they are comfortable using it. We have also worked with a number of older adults, both GNH residents and volunteers from the community, in the design of both a daily health survey to support residents in self-reporting their wellbeing, as well as in the design of feedback to inform residents of their wellbeing as gathered through both sensors and self-report. Our next step is to deploy this application and feedback to residents and to measure its effectiveness in terms of supporting residents in managing their health and wellbeing over a longitudinal period of time.

Acknowledgement

The CASALA Centre is funded under Enterprise Ireland's Applied Research Enhancement Programme with support from EU Structural funds.

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EASY, FAMILIAR, ENJOYABLE AND EMPOWERING NETCARITY SERVICES

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Abstract.

People do not experience technology; they experience services, made possible by technology. Technology fades into the background while services stand in the spotlight. Focussing on service delivery can be a driving force in making ambient assisted living a reality. It visualizes the possibilities and creates the need to look in detail at the steps needed to offer a service in practical terms. This practical approach is based on looking at service delivery from different perspectives: user, implementation/organization, integration, ethics and exploitation. In the NETCARITY[2] project this multi-faceted approach is adopted to be able to deliver services in real homes during and after the project.

Keywords: User centred design (UCD), smart home technology, interfaces, service delivery, Ambient Assisted Living (AAL), interoperability, exploitation, ethics.

1. Introduction

The main objectives of ambient assisted living initiatives were originally to provide responses to factors such as the ageing population, the growing prominence of chronic diseases and financial challenges in controlling overall healthcare spending. However, increasingly a shift is taking place from looking at the issue from a problem oriented point of view to an opportunity oriented point of view. ICT for ageing well represents a substantial market where European industry can play a leading role via the provision of innovative technological and organizational solutions [1,2].

In Europe there will be a growing number of older people living alone and in need of (intensive) care, an ageing workforce in general, and more financially well- appointed and wealthy senior citizens ready to enjoy their third age. These will spend money on products that secure their wealth, safety and security, and will have significant entertainment and communication needs [3].

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[2] NETCARITY (A networked multisensor system for elderly people: healthcare, safety and security in the home environment) is an Integrated project supported by the European Community under the Sixth Framework Programme (IST-2006-045508). Website: www.netcarity.org

NETCARITY focuses on the AAL domains of ageing well at home and ageing well in the community. Emphasis is placed on services that are not specifically targeted at a disease or illness but services that offer support in the area of wellbeing and inclusion. This is in line with the holistic approach as taken by Lowe [4]. The essence of this holistic approach is presented in Table 1, which describes the top-level needs, the electronic support and the challenges that need to be tackled.

Table 1. AAL Needs – Support – Challenges [4]

INDEPENDENT LIVING REQUIRES:	ELECTRONIC SUPPORT CAN HELP A LOT IN THE FORM OF:	BUT THERE ARE CHALLENGES:
a secure environment, peace of mind	proactive environmental sensors and assistive	currently too expensive, reimbursement issues
food and drink I like	monitoring of meals dietary help, internet shopping	need for standards for smart labelling and packaging
contacts with friends and family, including giving reassurance	user-friendly communication	
physical, social and mental stimulation	local media, local activities, employment / occupation, voluntary work	little local and personalized content available
healthcare in my home, comfort, peace of mind	telehealth sensors, medication reminders, medication management	presently telecare and health systems incompatible
certainty that my carers will come	electronic carer monitoring and communication	
appropriate response when things go wrong, peace of mind	appropriate response team, proactive calling	how? can one team deliver? cross-organizational issues with respect to business models and responsibilities

The social aspect of a service is important for the quality of care that can be delivered. This “care with a face” is achieved by exploring what is the best way to help a client by looking beyond the request at hand and focusing on the life story of the client. What somebody has experienced makes that person who he or she is [5]. A care professional offers help, but the client remains responsible for making decisions. The relationship is based on respect and mutual trust. The developed NETCARITY services provide additional means for making this vision reality.

2. User Centred Design

The NETCARITY services are defined by going through an iterative process involving older persons, informal carers and professional carers. A stepwise approach applying generative techniques was taken to gain a good understanding of the environment in which the NETCARITY services will be offered, what the features of the services should be, and how older persons as well as care professionals would like the interface to look and feel.

The basic principle behind user involvement in a design process, by means of generative techniques, is to reveal tacit and latent knowledge [6,7]. People do this by making designerly artefacts and telling a story about what they have made. The process of making artefacts, such as drawings, collages and models, enables people to access and express their experiences. Especially in their stories, there is rich and useful information for designers and researchers. To prepare the participants for such a creative session and to get the best information possible out of it, it is of great importance to sensitize them in advance. Sensitizing is a process where participants are triggered, encouraged and motivated to think, reflect, wonder and explore aspects of their personal context in their own time and environment.

The first step in the user centred design (UCD) process was to gain insight into the older person and their home environment. The environment as a whole, including for instance social contacts, options for support and services, location of the home and the (medical) problems people face, is responsible for the overall satisfaction of the residents. By using a questionnaire and doing home visits an overview of the environment of the older persons could be generated. The second step was to identify the main areas of interest for older persons, informal carers and formal carers when talking about services that would enable somebody to live independently. The third step used cartoons with triggering questions to take the step from main areas of interest to detailed services.

To be able to offer these services a service centre (SC) is needed. So from the fourth step on the user research was split into activities focussing on the interface for older persons and activities focussing on the interface for the SC employees. The work with older persons was targeted on the design of the shell of the interaction device. From the models that were created during the handicraft sessions criteria for the interface were selected. The user interface was developed in cooperation with older persons in focus groups and initially evaluated by observing the reactions to the interface during focus groups with older persons and formal carers and by showing it to visitors at exhibitions. Input from the SC employees was gathered by observing their current workflow, giving them insight into the services and the input from older persons, using paper mock-ups to start the creative process and showing them the look and feel of the interface every step of the design process and collect their feedback.

'Cartoons' of services

Design of user interface

Usability test interface

Mock-up SC interface

Focus group formal carers

Demonstration at exhibition

Figure 1. Impression of the steps of the user centred design (UCD) process

The final step of the UCD process is to test a sub-set of the NETCARITY services in a total of eighty homes in the Eindhoven region in the Netherlands and to show the complete set of NETCARITY services to a variety of stakeholders in a laboratory environment. This distinction was made due to the fact that some of the innovative parts of the NETCARITY services are still in the development process and not already proven to be reliable for use in real homes. Feedback form participants in this last phase of the UCD process will therefore be used as design input for further development of services and/or as evaluation of the current NETCARITY services. Evaluation will be performed by analysing data on the actual usage of the services in real homes, logging of usage data, questionnaires, interviews and observations. Topics of the evaluation are, among others, motivation to approach the services, service quality, perceived usefulness, perceived ease of use, enjoyment, intention to use and usage behaviour.

Research findings coming out of this project should lead to scalable products and systems that can support older people, and generate an understanding of how older people adopt and use technology which can support the wider AAL community. The overall goal of the pilot phase is proof of concept and vision towards service delivery after the project duration of NETCARITY.

3. NETCARITY system and interfaces

The NETCARITY system consists of a home network (home gateway and one or several user interfaces), a network at the service centre (web-based application with PC and mobile client) and the central NETCARITY server (host of NETCARITY services and storage of centrally available information).

The vision of NETCARITY is that the end-user interface should lower the threshold for older adults to start using new technologies, by making them easy, familiar, enjoyable and empowering. Empowering design is all about providing tools and services that empower and enable people themselves to address their social, rational and emotional needs. Studies conducted on the usage of IT technologies by older persons demonstrate how the reluctance to adopting communication technologies is not only due to a lack of skills but, above all, to the absence of perceived advantages and benefits [8].

The main interaction device for the older end-users is a touch screen which can be used to acquire welfare, safety, inclusion and communication services. The touchscreen is envisioned to be the 'window to the world' that allows them to take part in modern society and to receive assistance when needed. Familiarity, intuitiveness and consistency were the guiding aspects of the interface design.

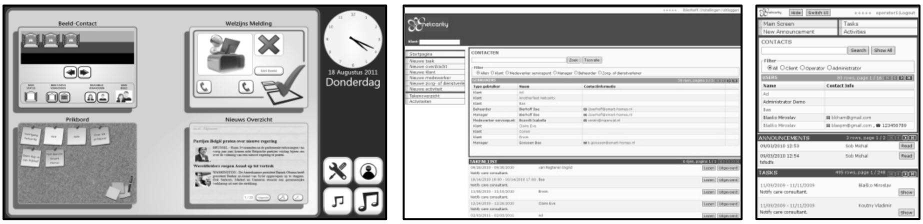
Several studies report the implications for the design of digital technology of age-related changes in functional capabilities [9]. Perceptual, motor and cognitive capabilities change with ageing. Designing technologies for older adults means, first of all, to carefully take modifications in these abilities into account. Indeed, usability problems often lead to older people experiencing dissatisfaction when operating with technologies, with the eventual consequence of rejecting them.

Changes in motor abilities include: slower response times, decline in the ability to maintain continuous movements, disruptions in coordination, loss of flexibility and greater variability in movements [9]. These changes have implications, above all, for the performance of older adults in using mouse and keyboard (e.g., point and click, double click, and dragging are difficult). Lots of studies suggest considering alternative input devices. Within the NETCARITY project a touch screen was chosen as the alternative input device. The decline in motor abilities was taken into account by making it possible to set response times individually, avoiding the need for continuous movements by offering the possibility to use buttons to scroll, making buttons large to select them easily, and by making it possible to select a button by pushing on it, sliding over it, and holding it down for a short or long time.

However, even if touch screens work better as an input device than a mouse, the performance on touch screens may be compromised by the reduction in cutaneous sensitivity, or by physical strain and fatigue due to the pressure required to operate touch screens [10]. One feature related to the use of a touch screen is the surface slope. The preferred surface slope is closely linked with the activity taking place on the touch screen. The touch screen is used in a vertical position since this is optimal for reading and talking, the two major activities related to the NETCARITY services. However, some services require textual input. It was decided not to use an on-screen keyboard or gesture recognition, because of the lower fine motor skills of older people, and to avoid fatigue, especially when using a touch screen in a vertical position. An additional keyboard, placed horizontally, is provided.

By using a zoom-based interface, direct feedback is available after selecting an object and by increasing the size the visibility increases. To support the end-users in knowing where they are in the system, layers which diminish in size are projected on top of each other to be able to recognize lower layers. User controls on lower layers are covered up by the upper layer to make them unusable.

All the services are represented by miniatures. On the one hand, each service must be consistent to enhance usability, but on the other hand all miniatures should be unique to easily distinguish and recognize the services. Services are offered on a modular basis. A distinction was made between using a service and editing the characteristics of a service. This was done to empower advanced end-users to personalize the system themselves without overstraining less experienced end-users. Less experienced users can contact the SC to make alterations to the settings for them. To trigger end-users to play and get familiar with their touch screen also, fun related services like internet radio and a game are included.



User interface *PC client service centre* *Mobile client*

Figure 2. Main screen of the NETCARITY user interface and service centre (SC) interface

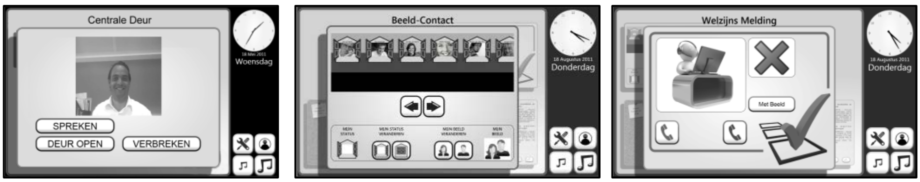
4. NETCARITY Services

As part of the UCD process within the NETCARITY project, possible end-users of the system expressed that the following services would provide added value for them personally.

The **Doorkeeper** service is targeted at safety. The service is divided into three sub-services. The older person can see who is outside their front door, each visitor is automatically recorded, and in case the older person feels insecure a second opinion of a SC employee can be requested. In line with the approach of Boers [11], the focus is not on reducing feelings of unsafety but rather on increasing feelings of safety. Older persons consider safety to be one of the important pre-conditions to live well independently.

The **Contact with family and friends** service is targeted at communication. The NETCARITY interface is used to enable video communication between users, their peers, family and friends. The NETCARITY solution is open source (SIP based) and therefore allows non NETCARITY users to use this service also. It allows the older persons to initiate/receive video-calls only to/from those contacts that are registered for them within the NETCARITY system. The goal of this service is to combat isolation which is often associated with old age and has been identified as a risk factor for a number of health (both physical and mental) and health-related problems [12-16] and to offer the older person the possibility to take part in the trend of video communication.

The **Good morning** service is targeted at welfare. There is daily video contact between the older person and an employee of the SC to ensure that the older person is well and to address any immediate needs for assistance. It is essential that the SC employee shows interest in the daily life of the older person. The focus is not necessarily on care but on things that occupy a person, care can be part of that. The basic periodicity (every day during a given time period) of the good morning service can be configured for each older person, based on his/her needs.

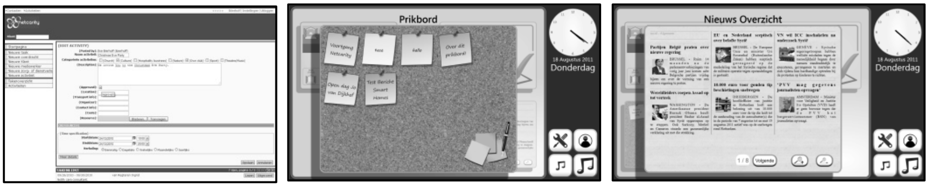


Doorkeeper *Video contact* *Good morning*

Figure 3. Doorkeeper, contact with family and friends and good morning service

The **Information on activities** service highlights events that are interesting for the older person based on user profiles and encourages participation in activities outside the home. Information is supplied by SC employees and contact persons of the older person. Older persons should be engaged in activities that interest them, are suited to their needs, and allow them to apply their knowledge and skills. They should increase the level of awareness of the need to learn, change and discover new experiences. In this way, attitudes towards participating in activities would change, reinforcing the role of the elderly in the community also as contributing member of the society [3].

The **Pin board** service can be used by older persons to see short messages of contact groups, like friends or the neighbourhood and to post information on the board themselves. The **Newspaper** service provides the latest news to the older person. The information on activities, pin board and newspaper service are all targeted at entertainment and inclusion, but have their own characteristics and can appeal to different types of persons. When providing services it is important for service providers to acknowledge individual differences [17-18].

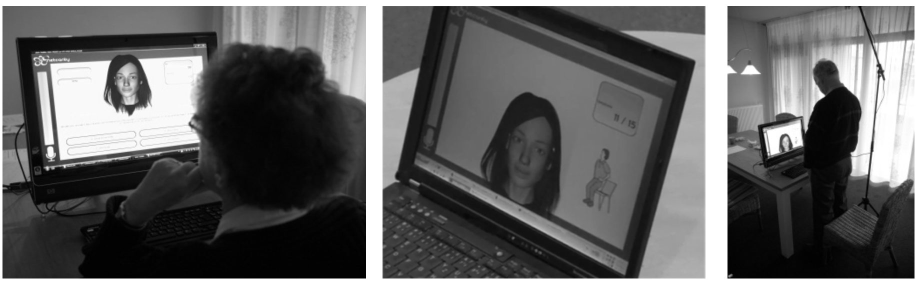


Entering new activity *Pin board* *Newspaper*

Figure 4. Information on activities, pin board and newspaper service

The **Quiz** is based on the TV gameshow ‘Weekend Millionaires’ and consists of multiple-choice questions. The purpose of this quiz is fourfold: (1) entertainment, (2) cognitive training, with questions specifically targeted at this goal, (3) collect experiences with operating the quiz via speech and (4) the use of an avatar as quizmaster. Several recent studies [19-20] have concluded that conversational avatars are a good tool for obtaining a more natural communication with a user.

The **Exercise** service is based on the fact that performing exercises on a regular basis has a positive effect on body strength, balance, wellbeing and quality of life [21]. This service stimulates older persons to perform physical training at home, not as a substitute for other ways to exercise but as an addition. At the moment a sensor is used to determine whether a person is sitting or standing. The final goal is to use simple sensors that allow the system to indicate if the person is performing the exercise correctly.

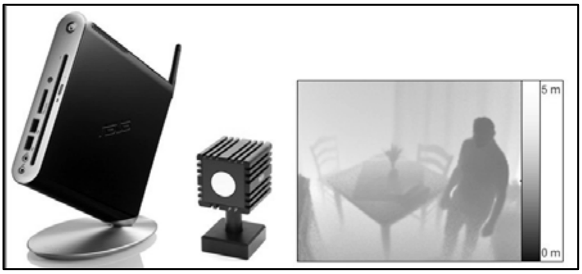


Quiz *Exercise interface* *Exercising*

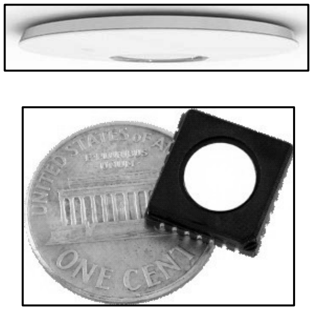
Figure 5. Quiz and Exercise service

The **Fall detection** service is based on 3D Position Detection (3D PD) and targeted at safety and feeling of safety. The detector is designed to support people living alone by detecting automatically the occurrence of critical events (falls) and gathering high level information (person's position and body posture) helpful for caregivers to provide the needed help. About 30% of people over 65 years living in the community fall each year [22]. In Europe, 40% of the people above the age of 75 need medical treatment after a fall [23]. The 3D PD technology overcomes the limitations of traditional camera-based solutions, such as typical problems due to darkness or brightness variations, camouflage effects, poor textured surfaces, shadows, and violation of privacy.

The **Fire detection** service is targeted at safety by using an innovative fire sensor. The NETCARITY fire detector is inspired by the fact that the nose is very sensitive to gases produced by fires so that a human being can smell a fire in a very early state. The optical smoke detector is replaced by a small chip, capable of detecting several gases which are significant for the presence of fire. It has a high reliability as regard to the detection of real fires and therefore substantially limits the number of false alarms. In addition to fire detection it provides measurement of temperature and humidity in the room, which can be used to increase comfort in the room, avoid damages caused by to high humidity levels and to safe energy, if it is used to control ventilation of the room.



3DPD, 3D camera, distance map captured by 3D sensor



Fire detector and sensor chip

Figure 6. Fall and fire detection services

5. Service Delivery

To fully experience the benefits of NETCARITY services it is vital that technological innovations are taken out of the laboratory and tested in real homes. Recently 80 homes in the Eindhoven region in the Netherlands have been equipped with the NETCARITY system. At the moment a subset of the services described in the previous section is being tested. This is due to the fact that some of the services are already market ready and some are still in the development stage. Final design iteration will be done based on the evaluation of stakeholders during the field trial and a demonstration of all services in a research facility. The focus of the field trials in real homes and the research facility is on different perspectives:

- End-user point of view, including informal carers
- Organization of services, especially SC of the involved care organization that plays a central role in the service delivery
- Technical integration, implementation process, maintenance, updates of the NETCARITY integrated system
- Exploitation of the NETCARITY services after the project duration

This multi-perspective approach is applied because all these aspects play a vital role in making sure that the services can be offered in real life situations to enable progress from showing technology and services in a laboratory environment to the actual installation of technology and service delivery in homes. If the services turn out to be successful, service providers will continue to offer the services after the duration of the NETCARITY project.

Assessment of service provision will be based on the alignment with current processes in SC, the added value of services for a care organization, the judgement of clients, experiences with maintenance, quality of service, and investment needed to offer services. The assessment provides input for business plans and can be a starting point for the SC to offer more comfort related and 'care at a distance' services.

Although not all services are tested in real homes the system is built in such a way that it is capable of expanding the number of services. This is done by building a modular system. Guidelines have been formulated that service providers must obey to integrate a service into the NETCARITY platform. By offering this possibility NETCARITY can be linked with existing services and platforms, guaranteeing the sustainability of the NETCARITY platform.

Acknowledgements

We are indebted to the older persons, employees of the service centre of Archipel and representatives from other stakeholders that have taken part and still take part in our research. Furthermore we acknowledge the work of the NETCARITY consortium members in the development of the NETCARITY services.

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ACTIVAGE: PROACTIVE AND SELF-ADAPTIVE SOCIAL SENSOR NETWORK FOR AGEING PEOPLE

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Abstract

Ubiquitous computing is shifting welfare for the elderly from traditional models, like family and in-hospital care, toward self, mobile, home and preventive care. In order to support this evolution, an ambient intelligent system is expected to provide personalized services at the right time, in the right place and in the right manner. This is the vision of ACTIVAge, an innovative approach for designing and developing user-centric services capable of dynamically adapting to the user's needs. ACTIVAge aims to be embedded in smart homes for the wellness of elderly people.

1. Introduction

Due to a substantial decline in the age-specific mortality of people within the last fifty years, elderly people have become the fastest growing age segment in most European populations.

With advancing age, older people are increasingly likely to suffer from various conditions which can impair independent living. Community care policies and socio-cultural values make family care the predominant model of support for older people across Europe. This model also fulfils the wish of many elderly people, who prefer to lead a safe way of life at home, to keep their own social context, to meet family members and friends, and to cultivate their own interests and hobbies, thus seeking support to relieve their loneliness and possibly their chronic illnesses.

On the one hand, a global increase of divorce rates, family mobility, numbers of women in the workplace and older age of female retirement is changing family patterns and, as a consequence, making it unfeasible to provide care for the elderly according to this model. On the other hand, economic constraints urge authorities to keep under control the costs of a centralized welfare system, by using in-hospital care,

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day services, institutionally-based respite care, holiday respite and home-based sitting services.

Information and Communication Technologies (ICT) are expected to address this challenge by supporting a paradigm shift in welfare delivery focused on the autonomous citizen and on the model of independent and high quality living, thus alleviating pressure on the overburdened welfare system as well as satisfying the users involved. This can only be achieved by providing a new generation of services that are distinguished from traditional ones by their ability to be personalized (i.e., customized to specific individual needs), self-adaptive (i.e., able to adapt, at run-time, to changes of the user's needs) [1], ubiquitous/pervasive (i.e., available at any place and at any time).

The integration of different technological approaches such as mobile computing, social networking, sensing components and knowledge representation can fulfil the above requirements and provide a context-aware world of ubiquitous computing [2].

2. Methods

ACTIVAge is an ongoing project at UNICAM[2] within the JADE project[3]. The project aim to develop a tool capable of monitoring and estimating the level of wellness of ageing people. The idea is to develop a particular class of sensors called social sensors, able to fetch and analyse the level of human-machine interactions using of Web services and human-environment interactions with regard to domestic objects and appliances.

2.1 The framework architecture

In the following we describe in detail the ACTIVAge three-layer architecture, shown in Figure 1.

[2] Ambient Assisted Living at UNICAM, available at http://www.cs.unicam.it/merelli/AAL/

[3] JADE project (Joining innovative Approaches for the integration and Development of transnational knowledge of clusters policies related to independent of Elderly), FP7-Capacities no. 266422, 2011-2013.

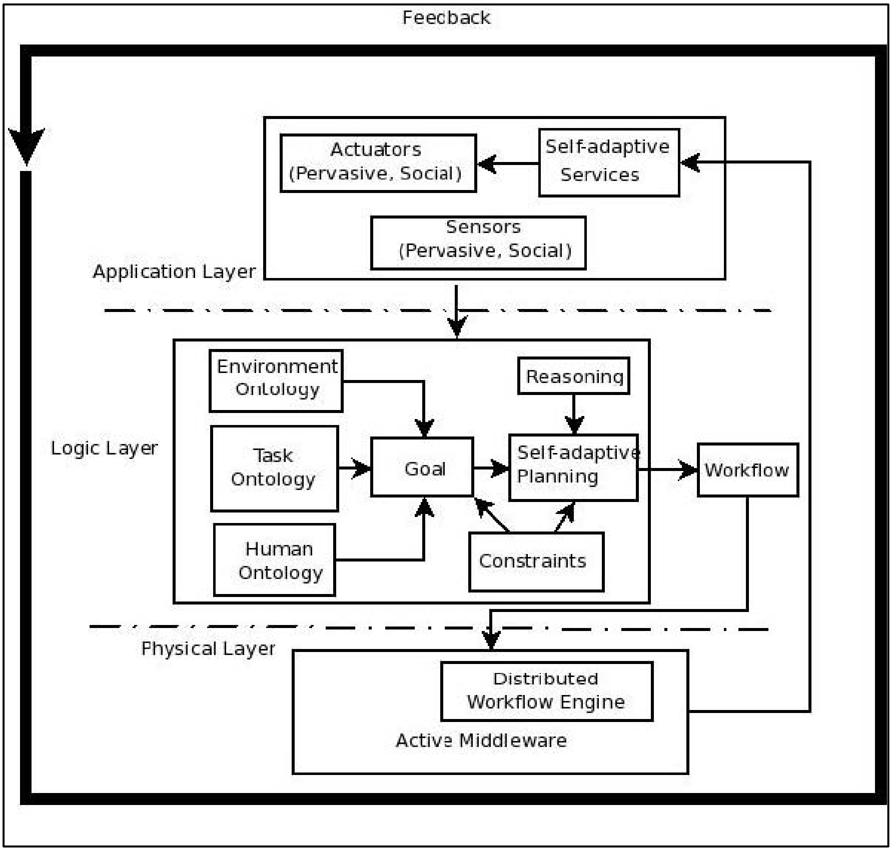

Figure 1. The multilayer architecture of ACTIVAge.

Application Layer. This layer aims at extracting and gathering sufficient information about the user through a number of pervasive and social sensors, so as to provide self-adaptive services by acting on the user's environment with actuators.

The pervasive sensors are sources of information gathered by static and mobile ICT devices; while social sensors are sources of information gathered by social networking and Internet services expressing the users' way of feeling.

If on the one hand, pervasive sensors – ranging from cameras, microphones, sensor networks, RFIDs, smart phones with gyroscope, to compass, accelerometer, proximity sensors and GPS – allow us to gather environment data, on the other hand, social sensors – like Facebook, Twitter, MySpace, LinkedIn etc. – can complement the available information coming from pervasive sensors.

The management of all this data enables a high level of context awareness.

The potential of social sensors can go much beyond that of pervasive sensors, allowing us to detect, elaborate and infer facts and events that exist only in the user's mind (e.g., individual's tastes, interests, preferences, future behaviours, etc.) and cannot be sensed by other pervasive sensing means. Both the pervasive and social sensor data provide the history of a user.

Logic and Physical Layers. Both layers combine knowledge representation and agent-based techniques for managing Semantic Web services, as well as semantic-driven workflows [3] for supporting the on-the-fly mining of user emotional data.
The Logic Layer aims at solving, in a transparent and automatic way, factors like semantic (meaning) and computational (interface of invocation) heterogeneity, level of awareness and physical distribution of resources.

The Physical Layer deals with the representation of real-world objects – sensors (smoke, temperature, door status, location of the user, social networking data, etc.), actuators (speech synthesizer, device regulators, emergency calls, social networking interfaces) and services – as software components communicating with each other.

2.2 The software development kit (SDK)

The integration of a Semantic Knowledge Management System (SKMS) with a Semantic Workflow Management System (SWMS) allows domain experts to edit services as semantic-driven personalized workflows, to run and to monitor their executions, to conceptualize them as a procedural knowledge and publish them in the form of SaaS (Software as a Service). In detail:

- a Web-accessible graphical interface enables the definition of services as activity workflows by a basic set of operators in the XML Process Definition Language (XPDL), the monitoring of their execution state, the management of the produced results, the conceptualization according to a corresponding Business Process Modeling Notation (BPMN) Ontology kernel and the storage as a SaaS concept in the Task Ontology.
- an agent-based middleware [4] provides the run-time environment for executing services as mobile and distributed code, enables the interaction with the external resources and allows the migration of workflow executors to different sites.
- an XPDL compiler translates workflow specifications into interactive component-based ones and generates the code to be executed on the agent-based middleware. The associated workflow specification is the coordination model describing how agents cooperate to reach a particular goal.

The provided SDK represents the domain-specific language for experts on ageing and healthcare [5].

2.3 The self-adaptive services

Self-adaptive systems should autonomously adapt at run time to changes in their operational environment to meet user's requirements better [6], and take the correct actions based on their knowledge of what is happening in the environment, driven by the events and activities [7] and guided by the goals assigned by their stakeholders [8].

From an architectural viewpoint, a self-adaptive service needs to implement some form of built-in feedback loop such as; collecting information, analysing it, deciding on further actions and performing them. Continuous interaction, collecting and conceptualization of information, detailed user's status and appropriate user's profiling are just the key issues to address the needs of elderly users at home, as well as carers, relatives, friends who – remotely by mobile devices or Web interfaces – can take smart and highly context-aware decisions about users.

Self-adaptive planning (see Figure 2(a)) is a vital aspect of self-adaptive systems.

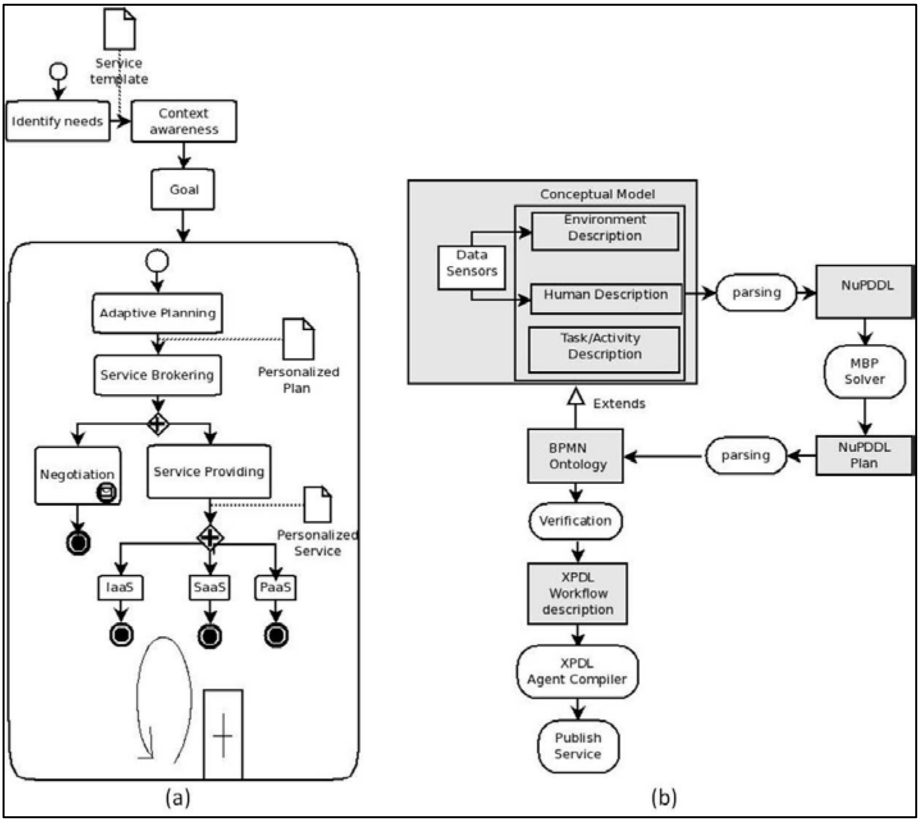

Figure 2. (a) High level business process approach to self-adaptive services; **(b)** Planning approach of a personalized self-adaptive service.

Applying formal languages such as XPDL, PDDL (Planning Domain Definition Language) and BPMN, enriched with semantics given by the conceptual model, agents can infer new knowledge useful to personalize a service.

In detail, the activity *Identifying (user) needs* extracts from the Conceptual Layer the user's needs reasoning over the knowledge base (i.e., T-boxes and A-boxes); *Context-awareness* makes it possible to contextualize the user's profile in a specific context looking at social and pervasive sensor input data; *Goal* adapts a generic (target) goal to a specific user's profile according to its needs; *Adaptive Planning* generates a tailored personal service specified as a workflow[4]; *Service Broking* determines what services, platforms, infrastructures, contents are needed to reach the goal; *Service Providing* provides the final personalized services to users; *Negotiation* allows the user to tune and further customize the service.

3. Conclusions

This paper suggests a methodological approach for designing personalized services for elderly people. We have sketched a method for developing self-adaptive services as services that dynamically satisfy the user's needs. The approach is based on a knowledge management system that analyses both environmental and emotional data.

Currently, we are exploiting ACTIVAge in the healthcare domain to develop a self-adaptive service of telepharmacy that, based on environmental [9], physiological and emotional data, regulates the drug dispenser and possibly the intervention of the caregiver.

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A FALL DETECTION APP FOR ANDROID PHONES

Frank Wallhoff[1], Eckhard Schmittendorf[1], and Jörg Bitzer[1]

1. Overview

Falls are the leading cause of injury-related hospitalisation of elderly people. In order to support independent living at home, an app has been developed to automatically detect falls and call for medical aid. A smartphone hosts a wide range of sensors that allow dense tracking of its user's actions by default, at no extra cost. The range of sensors typically includes a position transducer, an acceleration meter, a compass and GPS. The developed approach is integrated in an Android-OS-based application. The work undertaken was divided into three subtopics:

- An intuitive and user-friendly human-machine interface has been engineered so that the application can be easily used and handled without fear of false alarms. The preferences set-up, such as a standard text message and the phone number of the person to be informed, may be edited by the user.
- A wider range of models and manufacturers is available on the market, which means that a fall detection app has to be able to cope with a broad spectrum of potential sensors and specifications. As a consequence, the raw sensor data has to be pre-processed robustly.
- After the extraction of features, the body position and overall activity of the person are derived. Depending on the position of the device worn, different dynamic and characteristic patterns have to be trained and classified using pattern matching techniques.

2. Methods

In this study, the ability of various Android smartphones to support an automatic fall detection app was evaluated. All approaches were based on the built-in triaxial accelerometers which were read out at different sampling rates. A total of 82 data sets was derived from 18 subjects (age 51.9 y ± 20.9). Everyday motion was analysed: we studied unspecified motion patterns, including periods of walking, sitting and climbing stairs, together with a variety of falls. Subjects used waist-mounted phones with no specified orientation, simulating normal use.

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3. Results

With realistic motion scenarios, no typical acceleration pattern for falls could be identified. However, an algorithm for automatic fall detection was developed based on a combination of velocity and posture, both derived from accelerometer data. We found a sampling rate of approx. 40 Hz (the exact rate varied depending on processor load) to be best suited to this purpose. Data were averaged over full seconds for posture analysis. This approach yielded a robust fall detection with high sensitivity and specificity.

Figure 1. Upper left: raw data; middle left: position; lower left: activity; middle: app splash sceen; right: app preferences**.**

4. Conclusion and Acknowledgements

Smartphones offer an operational basis for automatic fall detection. An algorithm based on velocity and posture can reliably detect falls. Future work will use this algorithm as a basis for an integrated assistance system, supporting elderly people in their daily living.

This work has been funded within the internal research promotion programme at the Jade University of Applied Sciences.

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USABILITY AND ACCESSIBILITY FOR PERSONS WITH DEMENTIA

Riitta Hellman[1]

Abstract

The ability to take an active part in the self-service society should be sustained for as long as possible. Information technology can be used to support this. However, low accessibility of user interfaces is a serious barrier. In this paper, we present design principles that can make an AAL self-service technology accessible to the elderly. These principles form a set of guidelines that has been applied in the development of the assistive technology, Mylife. Mylife aims to support independence for older people with reduced cognitive function by giving them access to simple and intuitive services that are adapted to their individual needs and wishes. Mylife uses services available on the Internet, such as calendars, photo albums, music, news and communication, and presents them together on everyday devices with a touch screen. Mylife is flexible and can be gradually modified to follow the user's cognitive development.

1. Introduction

1.1 Background

The ability to take an active part in the self-service society should be sustained for as long as possible. Information technology can be used to support this. However, little or no familiarity with information technology represents a major barrier for many people. Another serious hindrance is low accessibility of user interfaces, i.e. solutions which fail to follow the principles of healthy and intuitive design. One example of established guidelines for accessible design is the Principles for Universal Design [1], developed by the NC State University, College of Design (USA). These principles support the design of products and environments that are usable by all people, to the greatest extent possible, without the need for adaptation or specialised design. In this paper, we present our work focussing on the design and development of an assistive technology (AT) for people with memory impairment. Based on available guidelines, such as those mentioned above, we have developed a set of practical guidelines to make an AAL self-service technology for the elderly that is as accessible as possible. Primary end-users are older people with cognitive impairment, for example people with early dementia, who live at home. Secondary end-users are those who administer

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and manage the assistive technology on behalf of the primary end-users. They may be spouses, children or other relatives, social workers or formal caregivers. Our main focus is on the cognitive aspects of usability and accessibility. These result from user involvement during the design process of the initial Mylife-prototype (AAL Joint Programme Call AAL-2010-3, Project no. AAL 2010-3-012; [2]).

1.2 Mylife in a nutshell

Mylife aims to support independence for older people with reduced cognitive function by giving them access to simple and intuitive services that are adapted to their individual needs and wishes. Mylife uses services available on the Internet, such as calendars, photo albums, music, news and communication (help), and presents them together on everyday devices with a touch screen. Tablets that are mounted in a stationary docking station, or are mobile or hand-held, can be used to display Mylife. Mylife is flexible and can be gradually modified to follow the user's cognitive development. When the primary end-user's capacity or interests decline, services (functionalities) can be simplified or removed. Caregivers administer the set-up, personalisation and content management of the Mylife product via a web interface. The service offered by Mylife supports time-orientation, communication and recreational activities (Figure 1).

1.3 Method

The initial Mylife prototype was developed in preliminary research projects in 2009–2010, financed by the IT Funk Programme of the Research Council of Norway [3]. This development included requirements analyses, conceptual development, paper prototyping [4] for the design of user interfaces, software development, and end-user and expert evaluations for HCI-solutions. Special attention was paid to the use and usability of the touch screens, including accessibility of the navigation and the presentation of information and functionality. End-user and expert evaluations included focus groups of people suffering from memory impairment (e.g. MCI or dementia [5]), dementia expert panels, demonstrations at senior centres and individual user trials. Requirements and accessibility design solutions for the secondary Carer's Web originated from other projects with similar web-design challenges, i.e. projects which include the development of web-solutions for secondary end-users, such as family caregivers or health personnel. The initial Mylife prototype was fed into the Mylife-project and is currently undergoing continuous development and evaluation in user tests and field trials during 2011–2012. In the remainder of this paper, the guidelines principles that have been developed in the Mylife-project are presented.

Figure 1. Mylife services presented on primary end-user's device (left). Secondary end-user's web for configuration and administration (upper right), including personalisation (appearance and choice of services), and feeding in of content, e.g. appointments/reminders to calendar, or photos to album(s).

2. Design guidelines

2.1 Cognition and accessibility

Accessibility problems are of particular concern to older people and people with cognitive disabilities. Indeed, an OECD report concludes that age exerts a strong influence on computer use, showing a significant decline after age 45. The findings show a clear negative association between age and cognitive skills [6]. Cognitively disabled people have difficulties interpreting what is seen or heard and/or difficulties making mental connections between different pieces of information, or have trouble with abstract reasoning. The type and degree of cognitive impairment can vary widely. Examples of cognitive impairment are learning and language disabilities, and dementia [7]. Cognitive skills or abilities, or the lack of these, thus define an important area of concern for the accessibility design of assistive technologies for older people.

2.2 Guidelines for cognitive accessibility

The principles that have been identified as important and therefore applied to the accessibility design of the Mylife user interfaces are:

1. Enable gradual simplification.
2. Enable direct manipulation.
3. Offer alternative modalities.
4. Simplify the language.
5. Make visualisations relevant.
6. Enable alternative presentation styles.
7. Model real world artefacts and their behaviour.
8. Make it easy to start from the beginning.
9. Acknowledge external communication.
10. Let the users be users.

In developing these principles, we have consulted the Principles for Universal Design [1].

2.2.1 Enable gradual simplification

Persons with dementia will experience increasing cognitive loss. In order to compensate for this development, the service should be designed to allow gradual simplification. Mylife is designed so that both the service categories and the content they contain can be simplified. The main service structure consists of the services Today, Calendar, Fun (with several sub-categories) and Contact. This selection can be reduced to any number of services, according to the primary end-user's needs and wishes. The simplest possible alternative is one single service, e.g. Today, or just one photo album.

In Figure 1, two versions of Mylife are shown: the stationary tabletop version contains two services, visible as two menu buttons at the bottom of the screen. The hand-held version contains all four categories of services, shown as a "full row" of menu buttons at the bottom of the screen. In Figure 2, a simplified Menu is shown.

2.2.2 Enable direct manipulation

Traditional PCs with key-boards and other manipulation devices may be difficult for people with low ICT-skills or with a cognitive impairment to use. Indirect manipulation of objects and functions on the screen challenges the cognitive apparatus. The new development of touch screen-based devices, such as smartphones and tablet PCs, offers help to many users. Our empirical research with elderly users indicates that direct manipulation on touch screens shortens the learning period remarkably, is less "frightening", and supports intuitive use. In Mylife, the keyboard is totally eliminated, and all use by primary end-users is based on touching the screen. The challenges are connected to the size of the touchable areas, which need to be large enough that they are easy to hit, even with slightly trembling hands. Therefore, this type of equipment requires careful interaction design even if the direct manipulation interface would appear as "automatically simple" at first glance. Even physical access and use is made easier by touch screens: assistive technology such as Mylife may be placed anywhere at the home, e.g., in the kitchen or on the coffee table. It is clearly preferable that only one piece of equipment occupies the physical space. Moreover, hand-held tablets allow a certain freedom of movement indoors (Figure 1).

Figure 2. Left: Icons and text for all menu choices at all menu levels (here in Norwegian). Middle: Simplified menu. Right: "Today" page of Mylife (here in Norwegian).

2.2.3 Offer alternative modalities

In the case of cognitive challenges, multi-modality may support the user. Obvious alternatives are text, images and sound. The user should be able to choose text and other information elements to be read aloud. In Mylife, texts treated in this way are calendar appointments and reminders, menu choice buttons and photo texts (Figure 2). For the buttons in menus and other choices, both text and icons are clearly preferred by the informants. Many of them prefer that the button texts are additionally read aloud, i.e. three simultaneous modalities are required.

2.2.4 Simplify the language

In expert evaluations, focus groups and individual user trials, the use of language has been an issue. The main task during the development of the Mylife prototype has been to find as simple and short expressions as possible without losing information. (Here, we focus on the language used in the text elements of the Mylife system itself, not the texts that are written by secondary caregivers in the calendar or photo albums). Two examples of simplifying the language are the menu buttons, and the way in which the time of day is shown. When designing the menu buttons, the focus has been on creating synonyms. For example, the main "well-being" category, as shown in Figure 2, is about entertainment. Examples of the development of compact terminology are:

Entertainment → Pleasure → Fun / Joy (English)	*It is day → DAY (English)*
Underholdning → Til glede (Norwegian)	*Es ist Tag → TAG (German)*
Unterhaltung → Vergnügen → Spaß (German)	*Det er dag → DAG (English)*

2.2.5 Make visualisations relevant

One of the initial project activities preceding the Mylife project was the analysis of icons (all menu choices are visualised). In order to determine the best possible icons, rather large sets of alternatives were ranked by potential end-users. The approach was two-fold: the informants were asked what they consider different icons represent (e.g. smileys, playing cards, note, camera etc.), and were asked to rank alternative icons for each specific object or class of objects (e.g. different types of telephone for communication, or different types of cameras or photos for photo albums etc.). This type of approach gives valuable information on the relevance and acceptability of visual material. Our conclusion here is that finding the best visualisations requires collaboration with the actual users; there is no such thing as a "universally best icon for music". Two particular findings deserve to be mentioned, however. 1. Old-fashioned icons for camera or telephone were clearly unpopular, not because of difficulties in understanding the *meaning*, but because of the underlying signal of being *designed for older users*. Elderly people use digital cameras and mobile phones. Some of them prefer a digital representation of time rather than analogue, and so on. Modern artefacts should be used as icons for modern people. 2. Symbols and icons that computer scientists have established as standard representations, such as a picture of a house ("home") in browsers for the start page, do not communicate well (if at all). These have to be avoided.

2.2.6 Enable alternative presentation styles

In this paper, the focus is on usability and accessibility for persons with dementia. For them, visual clarity is important to combat cognitive challenges. Many elderly end-users also have visual impairments. This has to be taken into account in the design of the user interface. The pieces of advice given in the previous chapters all contribute to this. Visual clarity can be enforced by high contrast. For those users who prefer this, such an alternative should be offered. In addition to the requirements set by low vision, alternative presentation styles may satisfy the end-users' requirements concerning aesthetics. Additionally, the clock on the "home" page may be either analogue or digital. In Figure 3, two high-contrast variants of Mylife are shown with a traditional analogue clock.

Figure 3. Left: Black and white high-contrast user interface of Mylife. Middle: Progress bar showing the status of downloading a newspaper. Right: Acknowledgement of message sent to contact person (caregiver).

2.2.7 Model real world artefacts and their behaviour

People with cognitive challenges have to make an effort when they use information technologies. The conceptual models and the interactions differ from the operation of most other technologies or everyday artefacts. Our recommendation is to model known real world objects and their behaviour. Mylife examples of this are the clock (that is shown in many of the figures), the monthly calendar and the photo album. The calendar resembles the design of traditional wall calendars, and the photo albums are operated by commanding Mylife to "turn over leaf" (Figure 2). Most test users have preferred this explicit command mode of leafing through the album, compared to other options on a touch screen, such as a continuous panorama or "dragging" photos over the screen.

2.2.8 Make it easy to start from the beginning

Navigation is known to be one of the most critical usability factors. The main navigation should be placed identically on all "pages" and critical functions should never disappear. In Mylife, "Today", as shown in Figures 1 and 2, is the starting page, and is always visible. This enables the user to start from the beginning at any time. The interface should also clearly express where the user is in the dialogue, and which "tasks" are active. In Mylife, this is implemented as differently framed and coloured menu buttons.

2.2.9 Acknowledge external communication

In the current version of Mylife, mainly two functionalities connect explicitly to external resources. These are "News" and "Communication (Help)". News is electronic newspapers that are downloaded from predefined URLs. Depending on the network connection and the amount of data to be downloaded, the user may need to wait for some seconds. Understanding that this is not "inside" Mylife is an important usability factor for the end-user. This is illustrated by a progress bar, as shown in Figure 3. The progress bar also tells the end-user that a newspaper is being *fetched* from outside the Mylife system. (The word ‘download’ is not used in order to keep the Mylife language simple and understandable; cf. Chapter 2.2.4). When the Mylife-user needs to contact her/his caregivers, the Help-functionality sends a message to predefined recipients. Acknowledgement of this very communication is then shown to the user (Figure 3), who would otherwise not know if something had happened or not, and might become uneasy.

2.2.10 Let the users be users

The configuration, administration and content management of the primary end-users Mylife system is conducted by the secondary end-user through a web-interface. The Carer’s Web allows the secondary end-user to choose the appearance, select and delete functionalities, add and remove content, maintain lists of Help-message recipients etc. (Figure 1). The primary end-user, on the contrary, does none of this; he/she simply uses his/her Mylife. This division of labour is implemented in order to make the primary end-users experience as relaxed and simple as possible. Also, the caregivers know the primary end-user, and are likely to be able to make necessary adjustments even if the primary end-user could not communicate all needs and wishes. “Engineering tasks” must be allocated to carers or other computer-literate helpers.

3. Conclusions

New accessibility challenges have arisen in parallel with advances in information and communication technologies (ICT). New groups of users are entering the scene, such as elderly people and those who need assistive technologies. In this paper we have approached accessibility for one specific assistive technology, implemented on a touch screen device. Another ambition of the Mylife project’s accessibility approach is to implement an interactive design that makes user instructions superficial. This will, of course, not always be possible. For high-value user guidance, the following alternatives will be implemented for the secondary end-user (Carer’s Web): 1. immediate contextual help; 2. downloadable “how-to” manuals; 3. screen casts; and 4. frequently asked questions. For the primary end-user, simple manuals show each “page” of Mylife with a simple explanation. An explicit goal is to produce understandable, inspiring and innovative user instructions. On-line user manuals and operating instructions will be designed to support both primary and secondary end-users. By combining these approaches, high accessibility can be reached.

Acknowledgements

This research is supported by the Ambient Assisted Living Joint Programme (www.aal-europe.eu/) and the IT Funk programme [3]. Special thanks go to Lars Thomas Boye of Tellu AS [www.tellu.no] for implementation of Mylife’s accessibility features, and to Inger Hagen of Forget-me-not AS [www.forglemmegei.no] for her advice on how to design for people with dementia.

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SMART COMPANION: A MOBILE COMPANION FOR OLDER ADULTS

Francisco Nunes[1], Paula Alexandra Silva[1]

Abstract/Summary

Smart Companion (SC) is an Android customisation for senior citizens. The current prototype includes tools ranging from messaging to music applications which support the daily tasks of this specific target group. In order to accommodate their needs and characteristics effectively, the project was based on close and systematic contact with end-users and the application of user-centred design methodology.

1. Introduction

Technology has the potential to bring numerous benefits to older adults' lives. Studies [1] suggest that touchscreen devices like smartphones can remove barriers that have kept older adults from starting to use technology in the past by enabling direct manipulation of the user interface. Unless user interfaces consider elderly people's specific traits, they are likely to miss out on technology's advantages. Mobile phones, for example, have great acceptance rates among older adults; however, a questionnaire applied to a group of 35 senior citizens (aged 58 to 91, mean age 71) revealed that current mobile phone user interfaces are far from adequate. According to the results (Figure 1), 82% of elderly people were able to start a call, but only 29% were able to send or read a text message.

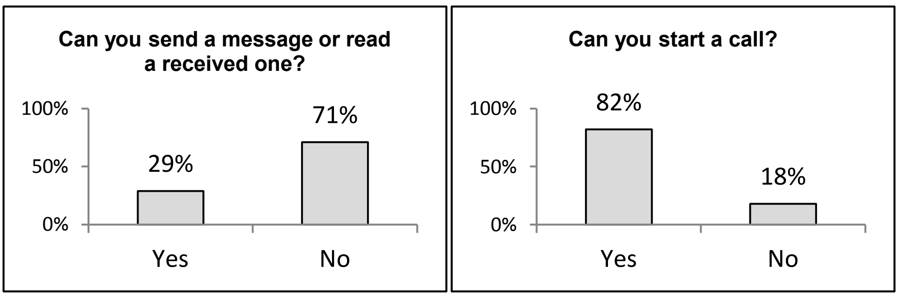

Figure 1 Percentage of users who can send or receive a message (left) and start a call (right)

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2. Smart Companion: A Mobile Companion for Older Adults

SC consists of a set of Android applications which support the daily activities of senior citizens. At present the project includes the following applications: (1) calls, (2) text and voice messages, (3) emergency calls, (4) radio player, and (5) music player. These applications are complemented by home screens and phone unlockers specially designed to respect older adults' skills.

The typical development cycle for each of these applications began with a user research phase informed, for example, by a literature review, informal interviews, or questionnaires. This was followed by the creation of low-fidelity prototypes, which were iteratively evaluated through usability tests with end-users. As a final result, a functional prototype was developed, as exemplified in Figure 2, by a set of randomly selected screens.

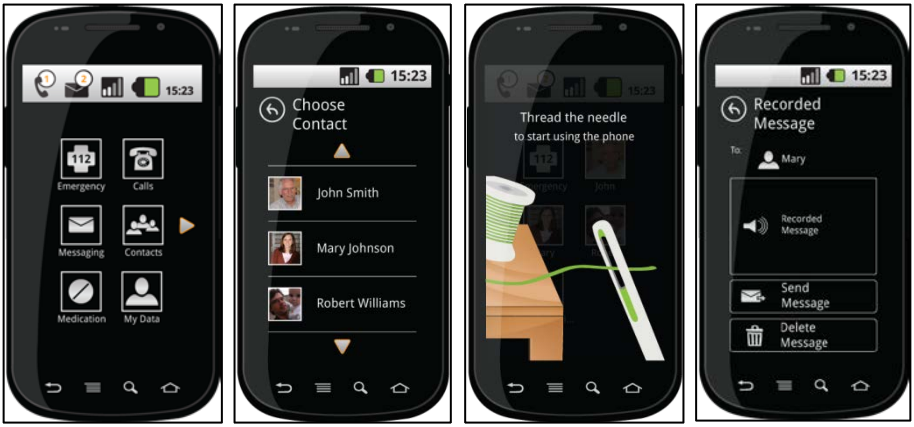

Figure 2. Examples of Smart Companion screens

The authors performed about 40 usability tests with an average of six participants per test at a daycare centre in order to evaluate and improve the applications along different dimensions including the graphic and interaction design as well as the information architecture and content. As a side result of these tests, the authors received confirmation of the users´ receptiveness towards SC through their informal feedback.

3. Lessons Learned

The evaluations performed with end-users enabled the authors to derive user interface design recommendations, including:

1. Use a large font size. Usability tests showed that font sizes under 25px (for 800x480 screen resolution) were not very legible to most participants.
2. Convey one single message at a time and be strongly sequential to reduce confusion caused by too many options.
3. Test icons and labels, as older adults' mental models are likely to differ from those of other age groups.
4. The swipe gesture is difficult for a great number of older users. For this reason, buttons, such as arrows, should be used instead of the swipe gesture.

4. Future Work

SC already meets several needs expressed by senior citizens; in the future, it will also provide applications addressing other areas such as: (1) prevention of isolation, (2) promotion of autonomy and quality of life, and (3) improvement of health monitoring.

Acknowledgements

We would like to thank the senior citizens and professionals of the Centro Social das Antas for their kindness and their participation in this project.

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ACOUSTIC APPLICATIONS AND TECHNOLOGIES FOR AMBIENT ASSISTED LIVING SCENARIOS

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Abstract

The support of people in care is connected with enormous temporal as well as personal efforts. Awareness of increasing the efficiency of today's care by using assistive technologies has arisen in recent years. Thus, the focus of this contribution is on the application of acoustic technologies to support users and care givers in ambient assisted living (AAL) scenarios. One of these applications is an intelligent autonomous system for acoustic monitoring of older persons developed within the project SonicSentinel. This system detects and identifies potential emergencies, with a significantly reduced false alarm rate compared to existing approaches. Furthermore, we investigated acoustic user interfaces for service robots in health care environments and retirement homes in the project ALIAS. Here, novel approaches for user–machine interaction using speech recognition techniques as a very natural user-interface will be investigated and evaluated.

Keywords: Acoustic Event Detection, Reasoning, Monitoring, Automatic Speech Recognition (ASR), Ambient Assisted Living (AAL)

1. Introduction

Demographic change has led to a continuous growth of the percentage of older people in today's society [1, 2] and, consequently, to higher costs for the social and medical care systems. One possibility to tackle this problem is to prolong the time for which persons live in their own homes independently and to use assistive technologies, such as reminder systems [3], medical assistance and tele-healthcare systems [4], personal emergency response systems, social robotics and safe human–robot collaboration [5], accessible computer-input strategies [3] and, more recently, mobile devices and smartphones. Such systems usually rely on application-dependent sensors, such as vital sensors, cameras or microphones. It has been shown that microphones can be integrated easily into existing living environments, are perceived as non-obtrusive sensors by the users, and can serve multiple purposes related to AAL [6, 7]. In addition to monitoring applications, acoustic signal processing strategies can also be

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used for interaction with technical systems [3, 8]. Due to the natural and ambient character of these approaches, they are preferred by older users if the recognition rate is sufficiently high [6].

In the following paper we therefore describe novel methods and concepts for human–machine interaction [9], i.e. acoustic event detection, reasoning [10, 11, 12] and speech recognition, addressing stakeholders from the sectors of health, transportation, multimedia, telecommunication and security. Sections 2 and 3 of this contribution briefly describe the work of the research projects "SonicSentinel - An Intelligent Autonomous System for Acoustic Monitoring" and "ALIAS – Acoustic User Interfaces for Service Robots in Health Care Environments", respectively. More detailed information about the overall system design and the methodology is also described. Preliminary outcomes and results of the projects are given in Section 4, and Section 5 concludes the paper.

2. SonicSentinel – An Intelligent Autonomous System for Acoustic Monitoring

The possibility of raising alarms in care environments in the case of an emergency is of great importance. Unfortunately, existing approaches are mainly based only on the continuous surveillance of sound level. Their inability to distinguish between various acoustic events leads to a significant false alarm rate. Within the project SonicSentinel, a novel intelligent embedded acoustic monitoring system for care institutions is being developed, aimed at automatic analysis of audio signals to detect potentially dangerous situations and to initiate emergency calls when necessary. One of the main challenges is the varying acoustic backgrounds, i.e. noise sources, which are considered to be the main reason for the imperfection of acoustic event detectors. We apply noise-robust model-based algorithms for emergency detection to reduce the false alarm rate to a minimum. Pre-filtering of the audio signal when speech is detected is also supported for the protection of privacy rights.

2.1 System Overview

As announced in one of our last works [11], we reuse the system proposed there in encountering the problem here. Basically, the system consists of three major modules: a preprocessing module for audio segmentation, pre-filtering and feature extraction; the actual event classification module for the specified events (cf. also Section 2.2); as well as an event modelling module which generates semantic information from the event data to model more complex events that cannot be detected directly from the audio signal. An overview of the system is given in Fig. 1. Please note that we do not address the event notification module in this contribution, since its implementation heavily depends on the desired application.

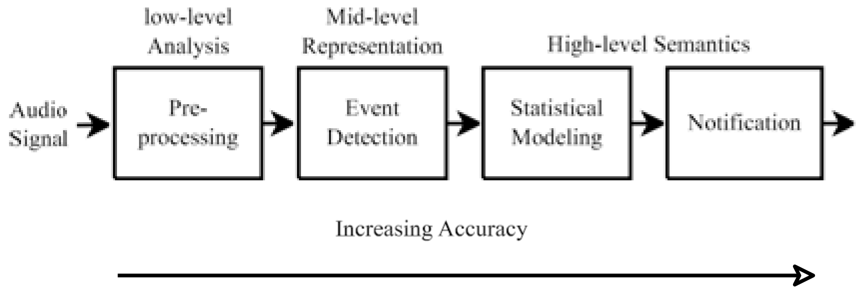

Figure 1. System overview in SonicSentinel

2.2 Data Gathering

The datasets used in this study consist of 17 acoustic events. We asked employees of retirement homes what kind of events it is important to detect and which of them should lead to an emergency notification. Additionally, we asked them to rank the events according to their importance, ranging from 0 (unimportant) to 5 (very important). In total, 15 different events were identified to be important: these are summarised in Table 1, together with the respective importance score.

Table 1. Acoustic events and their relative importance for automatic detection.

Acoustic Event	Score	Acoustic Event	Score	Acoustic Event	Score
shout out for help	4.67	shout out for nurse	4	fast breathing sounds	1.67
breaking glass	4.67	coughing	4	water tap	1.33
groaning	4.67	whining	3.67	speech	1.33
screaming	4.67	stertorousness	3.33	door	1.33
asphyxiation	4.67	moving furniture	3	singing	1.33
falling down	4.67	moaning	2.67		

Recordings were collected over a period of six months using six recording devices at six different retirement homes and care institutions, i.e. the project partners' locations. The recorded data was then analysed for ground-truth annotation and training of the acoustic event classifiers.

3. LIAS – Acoustic User Interfaces for Service Robots in Health Care Environments

It is the goal of the ALIAS project to develop a mobile robot platform to sup- port older persons in their daily life as well as to enhance communication and social interaction. Thereby, ALIAS will not make human-to-human communication obsolete, but will ensure the maintenance of existing contacts to prevent social isolation. Additionally, the user is stimulated to perform cognitive activities in order to preserve quality of life. A touch display and a robust speech recognition and synthesis system enable the ALIAS robot platform to interact with the user via speech or using the mounted touch display (see Fig. 2). In addition to communication with the robot by speech input and output, a central goal is communication with relatives and acquaintances via telephone channels, mobile phone channels and the internet. An automatic reminder system motivating the user to participate actively in social interaction has been developed.

Figure 2. ALIAS robot platform

Approaches for user–machine interaction using speech input and output as a very natural user-interface have been developed and evaluated in a user-centred design approach, as visualised in Fig. 3. Providing additional information to the users, supporting them in their daily lives, reminding them of appointments, keeping them company or simply motivating them to stay active throughout the day, are only a few examples of what service robots may be capable of achieving to prolong independent living using audio technology.

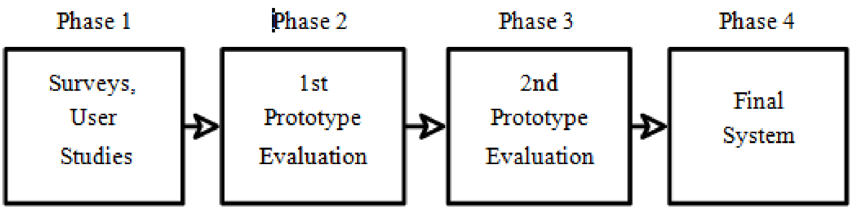

Figure 3. Design concept of the ALIAS platform

4. Preliminary Results and Work Progress

Within the SonicSentinel project, a database of audio recordings has been gathered by the project partners. First ground truth annotations are already available and allowed for the first AED experiments for algorithm development, i.e. acoustic feature extraction, feature selection and machine learning algorithms, and deeper investigations regarding expected acoustic backgrounds and privacy issues. The acoustic events of interest were ranked by experts according to their importance in the final application scenario (cf. Table 1). Additionally, a suitable hardware platform was selected for the embedded implementation of SonicSentinel.

Within the ALIAS project, a speech input and reasoning system, as well as a speech output system (text-to-speech), has been integrated with an easy-to-use graphical user interface specifically designed for older users. The needs and preferences of older users regarding human–machine interactions are constantly evaluated in a user-centred design process to optimise the human–machine interfaces of the ALIAS robot platform.

5. Conclusion

As exemplarily shown in this contribution, acoustic technologies have a broad range of applications in AAL scenarios. These range from acoustic monitoring, acoustic events and emergency detection, acoustic localisation, to signal enhancement and individual hearing support for communication applications. In particular, if the acoustic modality is combined with traditional input and output modalities such as touch panels, mouse and keyboard, an increased user satisfaction can be observed.

Acknowledgements

This work was supported in part by the German Ministry of Education and Research (BMBF) under grant no. V4KMU10/117, grant no. 16SV5291 ”Sonic-Sentinel”, grant no. 16SV5490 ”ALIAS” and the German Lower Saxony Ministry of Science and Culture through the ”Niedersa¨chsisches Vorab” grant programme (project GAL).

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ASSISTIVE TECHNOLOGY, IMPLEMENTATION AND LOCAL REQUIREMENTS; USER INTERFACE BASED ON USER PREFERENCES

Stefan Lundberg[1]

Abstract/Summary

In a five-year project called MonAMI, which was intended to demonstrate that useful services for elderly persons and persons with disabilities living at home can be delivered in mainstream systems and platforms, one of the findings concerned the importance of taking into account the implementation phase in people's homes. This has a particular influence on the kind of interface one can or should use. In one of the three test sites in MonAMI, in Stockholm, Sweden, we had to use a mobile interface to meet the users' demands instead of a fixed computer with a touch screen.

1. Introduction

Today all serious developers of assistive technology or ICT are strong adherents of user-based development. When this was first brought up as an issue, many years ago, it was a new idea for many but little by little the concept became a key factor if one wanted to stay in the field. All too often, however, users' needs are still not fully understood or not analysed appropriately when ICT support for the elderly is designed.

MonAMI is a five-year EU-funded project that has just finished. Its purpose was to demonstrate that accessible, useful services for elderly people and those with disabilities living at home can be delivered in mainstream systems and platforms. During the project different user interfaces were developed. In the beginning these were mostly to enable the developers to test the services, but when the project moved towards a living scale field trial (LSFT) an end-user interface was built and implemented for the trial. This was brought into the project with the support of designers and on the basis of tests with end-users belonging to the target group.

The LSFT trials were conducted in three countries: Slovakia, Spain and Sweden. Although the whole project was aimed at an improved understanding of how new technologies fit into the social and economic framework, and tailoring systems and

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interfaces specifically to the requirements of the elderly, the LSFT in Sweden ran into problems with the user interface.

2. Methods

A set of core services were selected to be tested by all three test sites and the user interface needed to be clear and intuitive to facilitate the users' handling of the system. The interface implemented in the project was based on an all-in-one computer with an inbuilt touch screen (ASUS Eee Top) that could be nicely fitted into the environment or even attached to the wall somewhere near the entrance of the user's apartment. The computer was also the hub of the whole system with Zigbee radio sensors connected to the OSGi platform that MonAMI was built around.

From the interface on the touch screen the user could control lamps, activate different alerts and alarms and receive information from a formal caregiver. That was our concept. The interface on the computer screen was not the problem. The problem was the computer.

3. Results

When it was presented to the potential users in Sweden they rejected the concept and asked for a mobile device, or rather a user interface that could be used and moved along with them throughout the apartment and not just left where a computer would have been standing. This was one reason why the users were reluctant to try our solution. The other was the fact that they were all living in small apartments, built for the elderly, and there was not much space for a computer. Putting the computer on the wall was not feasible because they already had their pictures on the walls, so the only place was on a table but that was also difficult because of the limited space. It could also have been the case that they already had a computer which was occupying the only available space. We had to admit that we had not foreseen this complication because we had been focusing on the service and not on the implementation in the users' home. The fact that our target group was living in apartments so small that even a small computer could not fit in without difficulty was not something we had in mind when working with the project. Still, we had to meet this group's needs. To meet our users' needs in our trial site, we developed an interface for a smartphone instead, which was presented to the users and accepted and approved. We did not know if the users would be able to handle a smart phone, but the fact that it could actually meet a real demand made it eminently suitable for the trial.

4. Discussion

The use of a mobile interface must, we think, be regarded as something that will be a trend in the future. The use of mobile phones is now reaching all ages, and it gives people with special needs a terminal that is not stigmatised and is therefore much more attractive. It is developing into an increasingly powerful device that can in many areas compete with the computer. Mobility is probably something that will be increasingly asked for in different situations. The trend today shows that people like to spend time on the mobile phone and they are doing more and more with it. They can watch films and television, listen to music, pay their bills, etc. with the mobile smartphone. It is only natural for this concept to be considered when support for the ageing community is on the agenda. Possibly a combination of a pad device and a smartphone would be the best solution for both indoor and outdoor activities.

5. Conclusions

We at CHB argue that the user interface must be one of the prime objectives in any work done in AAL projects. Negligence in this area can ruin an otherwise perfect set-up and well-designed solution. It is prudent to bring in the users as early as possible, both to reduce the time it takes to find out what they need and want and to discuss how it can best be fitted into their daily life.

At the end of the trial of MonAMI the other two sites confirmed that their users would also have preferred a mobile interface.

A HARDWARE/SOFTWARE FRAMEWORK FOR POSTURE RECOGNITION IN AAL APPLICATIONS

Giovanni Diraco[1], Alessandro Leone[1], Pietro Siciliano[1]

Abstract

This work presents a hardware/software platform based on a commercial Time-of-Flight (ToF) camera and a low power embedded computing system for the automated recognition of body postures. In order to accommodate several application scenarios, satisfying different requirements in terms of discrimination capabilities and processing speed, two approaches were investigated, namely topological and volumetric, and related performances were compared. The topological feature vector extracted from the 3D person silhouette encoded the intrinsic topology of the body posture in a skeleton-like representation, guaranteeing invariance to scale, rotations and postural changes, and achieving an efficient self-occlusion handling at a moderate computational cost. On the other hand, in the volumetric approach, postures are described in terms of 3D spatial distribution working within a wide range of distances and in a very fast way. Discrimination capabilities of the two approaches were evaluated in a supervised context, achieving a classification rate greater than 96.5% in both cases. The two approaches exhibit complementary characteristics achieving high reliability in several interactive scenarios in which posture recognition is a fundamental function.

Keywords. Ambient Assisted Living, Time-of-Flight 3D Camera, Posture Recognition, Feature Extraction, Topological Features, Volumetric Features.

1. Introduction

Many Ambient Assisted Living (AAL) applications, especially in health and homecare areas, exploit the inference of human activities in order to support the everyday living of lonely elderly people. Applications in these areas are devoted to supporting a wide range of needs, from prevention and detection of emergency situations (e.g. fall detection) to rehabilitation (e.g. assistance during exercise execution), by employing a variety of electronic devices and sensors (accelerometers, gyroscopes, cameras, microphones, etc.). On the basis of specific sensing principles, three main categories of device are identified: ambient-based, wearable-based and camera-based solutions

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[1]. The main advantages and disadvantages of each technical solution are summarised in Table 1. The ambient category relates to sensors that are embedded into appliances or furniture in order to detect presence, door open/closed, etc.

a)

b)

Figure 1. a) Hardware platform overview**. b)** A typical range image with the related gray scale distance. It is also apparent, as the person's identity cannot be revealed from range images.

In spite of its cheapness and simplicity, this solution requires typically an *ad hoc* design or redesign of the home environment. Wearable devices are normally based on accelerometer and/or gyroscope sensors. The solution does not require any environmental modification since devices are worn by the user; however, wearable devices are prone to be forgotten or worn in a wrong body position, exhibiting a low acceptance rate. Camera-based solutions require the installation of at least one camera in each monitored room, allowing the capture of most of the activities performed and avoiding, at the same time, a large number of ambient-based sensors. Furthermore, apart from being non-invasive, a camera provides a rich and unique set of information that cannot be obtained from other types of sensors. This paper focuses on camera-based solutions dealing, in particular, with the problem of human posture recognition, which is a fundamental prerequisite to the inference of human activity. The presented active vision-based solution allows the recognition of human postures with high reliability and in a privacy-preserving way. Moreover, the solution overcomes the limitations of the traditional camera-based solutions [2], such as typical problems due to darkness, brightness variations, camouflage effects, poor textured surfaces, shadows and complicated installation procedures. During the design of the system, particular attention has been paid to ethical aspects in order to maximise the user's acceptance rate and minimise the risk of loss of privacy.

Table 1. A comparison of technical solutions for human activity analysis

Solution	Advantages	Disadvantages
Ambient-based	Very cheap	Environment adaptation Poor set of information
Wearable-based	Cheap Large environment covered No environment changes	Intrusive Prone to be forgotten or damaged or worn in a wrong position
Passive Vision-based	Moderately cheap Not intrusive No environment changes Reach set of information	Problems due to darkness, brightness variations, camouflage, poor textured surfaces, shadows, occlusions, etc. Person's privacy violation Intrinsic and extrinsic calibration required
Active Vision-based	Person's privacy guaranteed Not intrusive No environment changes Reach set of information Only extrinsic calibration required	Expensive for now

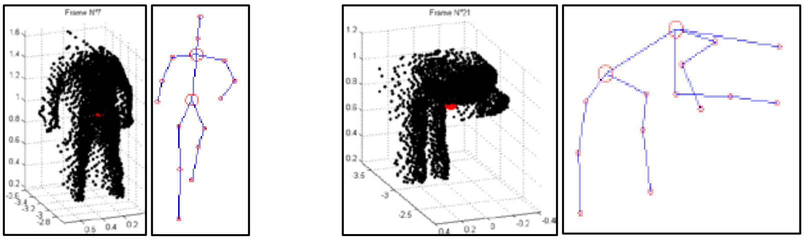
2. Materials and methods

2.1 The hardware platform

The hardware platform includes two main components: an embedded PC with an Intel® Atom™ Processor (see Fig. 1a on the right hand side) and Linux-based OS, and a 3D MESA SR4000 (www.mesa-imaging.ch) camera (see Fig. 1a on the left hand side) installed in a wall mounting static setup. The extrinsic camera calibration is performed in a fully automated way (self-calibration) in order to meet the easy-to-install requirement, whereas the intrinsic calibration is not required since the camera comes intrinsically calibrated by manufacturer. The SR4000 has very limited dimensions (65×65×68 mm), noiseless working modality, QCIF sensor resolution (176×144 pixels) and it covers a distance range of up to five metres (to avoid alias affects) within a Field-of-View (FoV) of about 43.6° (H) × 34.6° (V). Although the SR4000 camera can also deliver intensity images, only depth information is processed for posture recognition in order to guarantee the person's privacy (a typical range image is shown in Fig. 1b).

2.2 The software framework overview

All the algorithms included in the software framework are grouped into two functional modules. The first module provides well-established early vision and range imaging functionalities such as background modelling, foreground segmentation, people tracking, 3D centroid extraction and camera self-calibration. Further details on previously mentioned algorithms can be found in [3]. The second module is responsible for posture recognition, including algorithms for feature extraction and classification of four main postures: standing, bent, sitting and lying down. Features are extracted by following two approaches, named topological and volumetric, having different trade-offs between execution speed and amount of gathered postural details. Finally, the four main postures are classified by using a statistical learning methodology (refer to [4]) for further details on the adopted classifier). The discussion of the two feature extraction approaches is the subject of the following subsections.



a) b)

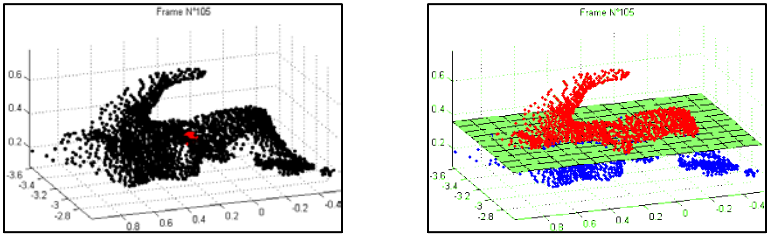
Figure 2. The 3D point cloud for the standing (a) and bent (b) postures with the related skeletons

2.3 The topological features

A generic shape, such as a human body scan captured by a range camera, is topologically described by using a special graph-based skeleton representation (a Reeb graph skeleton; [5]). In order to extract a graph skeleton an appropriate distance function (Euclidean, geodesic, radial, etc.) must be defined on the shape. Among all the above-mentioned distance functions, the geodesic distance is the only one to be invariant under isometries, apart from being invariant under affine transformations. The invariance under isometries makes it possible to recognise body parts regardless of the particular body posture: this is one reason that makes opportune the adoption of the geodesic distance. The other reason depends on the possibility of handling self-occlusions (a body partially occluded by itself) more effectively by using the geodesic distance. The graph skeleton is extracted starting from the range image and computing the corresponding 3D point cloud by using the camera's extrinsic parameters (provided by the self-calibration procedure). Hence, a connected 3D mesh is generated by Delaunay triangulation on the 3D point cloud, and the geodesic map is estimated by searching for the shortest paths on the mesh. Finally, the graph skeleton is extracted by computing the level-sets of the geodesic distance function with respect to the centroid of the 3D point cloud (Fig. 2). The interested reader can refer to Diraco, Leone, and Siciliano [6] for further details.

2.4 The volumetric features

The volumetric features exploit global information included in the 3D point cloud. In order to discriminate body postures, the 3D volume of the body is divided into distinct volumetric regions with respect to the canonical symmetry planes. Each body posture can be identified by a characteristic volumetric distribution inside the 3D point cloud. The volumetric distribution is quantified by defining two distribution functions with respect to two corresponding cylindrical volumes, one up and one down with respect to the horizontal plane (Fig. 3). Finally, the volumetric features are defined as the maximum slope values of the two functions and extracted by analysing their trends at the increase of the cylinder rays. Further details on the process of volumetric feature extraction can be found in Leone, Diraco, and Siciliano [4].



a) b)

Figure 3. The 3D point cloud for the lying posture (a) with the related volumetric features (b)

a)

	ST	BE	SI	LY
ST	1.000	0.002	0.000	0.000
BE	0.000	0.993	0.013	0.000
SI	0.000	0.005	0.983	0.006
LY	0.000	0.000	0.004	0.994

b)

	ST	BE	SI	LY
ST	0.972	0.011	0.000	0.000
BE	0.019	0.967	0.026	0.000
SI	0.009	0.022	0.966	0.013
LY	0.000	0.000	0.009	0.987

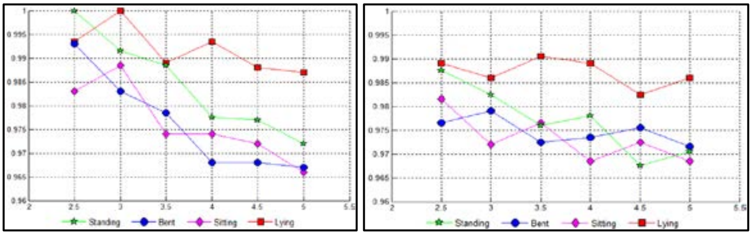
c)

	ST	BE	SI	LY
ST	0.988	0.009	0.000	0.000
BE	0.007	0.976	0.015	0.002
SI	0.005	0.014	0.982	0.009
LY	0.000	0.000	0.004	0.989

d)

	ST	BE	SI	LY
ST	0.970	0.011	0.000	0.000
BE	0.018	0.972	0.025	0.003
SI	0.012	0.017	0.969	0.011
LY	0.000	0.000	0.006	0.986

Figure 4. The confusion matrices for topological features a) at 2.5 metres and c) 5 metres, and the confusion matrices for volumetric features b) at 2.5 metres and d) 5 metres



a) b)

Figure 5. The classification rates at varying camera distance from 2.5 to 5 metres for both a) topological and b) volumetric features

3. Results

The four main postures, standing, bent, sitting and lying down, were simulated and processed in real-time by using the hardware and software system previously described. A large dataset of 1200 samples, 300 for each posture, was collected in order to evaluate the classification performance of the two feature extraction approaches. Postures were taken at various distances from the camera, ranging from 2.5 metres to 5 metres. Normalised confusion matrices are reported in Fig. 4 for both topological and volumetric features at distances of 2.5 and 5 metres, whereas normalised classification rates are reported in Fig. 5 for the other intermediate distances. Both topological and volumetric approaches (feature extraction and classification module) have been implemented on the embedded PC in c/c++ language achieving a good execution speed. The achieved execution performance results were compliant for monitoring and surveillance purposes. When topological features were used, the system worked at 5 fps with 87% of execution time devoted to the feature extraction process. Instead, the system worked at 15 fps by using the volumetric features with an execution time of 60% taken by the feature extraction process.

4. Discussion and conclusion

Two feature extraction approaches, topological and volumetric, for the classification of four main postures (standing, bent, sitting and lying) have been presented. The discrimination capabilities of the two feature extraction approaches were evaluated by using a statistical learning methodology and compared on the basis of a common dataset of basic human postures. The different discrimination capabilities and execution speeds offered by the two approaches allowed the different requirements exhibited by AAL applications to be satisfied. In fact, gathered posture details and operational distance from the camera are usually inversely proportional. For instance, rehabilitation exercises can be performed at a few metres from the camera (e.g. less than three metres) and many postural details are required in order to check the correctness of exercise execution, whereas critical events can occur at a greater distance from the camera (more than three metres) but a few postural details are usually sufficient for detection of critical events. The topological features describe the human posture at a high level of detail exploiting the full potential offered by range imaging: many body segments can be discriminated, such as head, trunk, arms and legs. As shown by the reported results, topological features exhibited the best classification rate up to three metres, whereas for distances greater than three metres results were comparable with those of volumetric features. However, the high level of postural detail achieved with the topological features was paid in terms of computational workload (up to 5 fps). Volumetric features reflecting the spatial distribution of the 3D point cloud provided a lower level of detail in posture discrimination, but they have the advantage of being less computationally expensive (up to 15 fps). The choice between one or the other depends on the specific AAL application. The results suggested a high accuracy of topological features at distances up to three metres, whereas beyond that range, volumetric and topological approaches give similar classification performance (greater than 96.5% in both cases). Although active vision systems are presently an expensive technology, a great effort is in progress in order to reduce manufacturing costs, especially with the gaming industry (www.xbox.com/Kinect) being strongly interested in new kinds of human–computer interaction modality. Ongoing work focuses on the definition of a dynamic selection of the appropriate feature extraction procedure in an application-driven fashion.

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HOMAGE FOR LIFE: A PERSONALISED SELF-SERVICE PLATFORM FOR THE AGEING-IN-PLACE INDUSTRY

Shoshan Shacham[1], Ramat Hasharon

Abstract

Homage for Life[2] is an ICT-based[3], 'best practice' innovative paradigm addressing the 'independent living' challenges of the twenty-first century. Meeting this challenge is powered by the potential for significant economic and social impact expected from the introduction – on a wide scale – of innovative AAL solutions. Although this potential has been recognised for some time, breakthroughs in terms of widespread availability and deployment of solutions have yet to be achieved. The way to proceed towards the Homage 2010 solution is presented here.

1. Introduction

Homage 2010, an Israeli innovation, provides a new, best practice, innovative approach for addressing ageing-in-place challenges. It offers a comprehensive solutions platform based on a wide range of interdisciplinary research, business participation (services, products) and currently available and implementable information technology tools and structures (i.e. ICT, internet, social media networking) to provide a sustainable, high quality, on-demand platform answering the needs of the ageing 70+ population.

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[2] Homage 2010, now in the advanced phases of structuring, began assembling talent in 2005. Its highly qualified team includes Israeli and international academic and business figures with expertise in such fields as: gerontology, geriatrics, psychology, health, medicine, finance, insurance, ICT, internet, construction, sales & marketing, venture capital and, last but not least, service provision (provision of helper services). Their impressive potential adds to Homage 2010's prospects for success.

[3] ICT: information communications technology

Homage 2010 supports the principles of:

(a) adding viability to the vision of living life independently in the place of one's choice, i.e. living in one's own home and community, surrounded 'virtually' by family and friends,

(b) providing full support when it is needed (and only then), by an effective, comprehensive, sustainable, on-demand system in line with the best practice model for Assisted Ambient Living.

2. Methods

The initial steps for making such a solution available are:

- providing an ICT-based, sustainable self-service platform that complies with the FP7 Multi-Stakeholders Partnership Braid Project framework (www.braidproject.eu).
- gaining the commitment of a respected segment of industries that would benefit from integrating their products in our platform solution,
- acquiring a significant 70+ end-user base.

In order to implement an ICT-based operational system successfully, at least five critical success factors need to be addressed:

1. establishment of a proven, mature ICT & internet infrastructure,
2. identification, analysis and prioritisation of 70-+ needs/aspirations,
3. commitment to participation by members of the 70+ group,
4. availability of a persistent, ongoing, self-service operational infrastructure (24x7),
5. initial commitment from significant players representing those industries that are expected to participate as service suppliers.

3. Discussion/Conclusions

The Homage 2010 initiative is based on current research regarding the changing needs and aspirations of the elderly and the potential of social media and emerging technologies to help meet these needs. It also addresses the new Danish welfare initiative regarding the elderly (see September 2010 AAL - *Ambient Assisted Living-Forum*, Odense).

Homage 2010 presents members of the ageing population with a platform that greatly enhances their ability to take advantage of the relatively new creative concept of enjoying required and desired support, services and social benefits while continuing life independently and unregimented in the environment of their choice, which is often the home and community of their middle age.

A 70-plus world offering this kind of choice is possible thanks to advances in many medical, technological and social disciplines that have made viable the possibility of catering to modern aspirations of the third age.

Currently, Homage 2010 is being actively deployed with the middle-class and upper-middle class population. This is a population segment often characterised by the need (sometimes financial) and desire to care for itself. Homage 2010 is dedicated to finding and making available economically viable, suitable, tangible and, most importantly, advantageous solutions for the third and fourth circles of life.

AAS-PLATFORM: A SOFTWARE PLATFORM FOR STREAMING AAL SERVICES

Reza Razavi[1]

Abstract

AAL services implement sophisticated interaction and coordination protocols, which must be regularly adapted to the changing conditions and needs of the elderly. We propose AAL service streaming environments, i.e. AAL systems that externalise the implementation of their AAL service protocols, and allow their runtime specification and ready deployment by means of a declarative language accessible to non-technical end-users. We further propose a software platform, AAS-Platform, which allows programmers to implement such systems through reuse and extension.

1. Domain Analysis

1.1 The complexity of AAL service protocols

Improving the quality of life of the elderly through Ambient Assisted Living (AAL) services entails implementing sophisticated interaction and coordination protocols which involve long-running activities and human interventions and unfold by orchestrating a potentially wide range of operations. The patterns of interaction among those operations can be complex. The sources of data, the processing and decision-making algorithms, and the interaction media are often heterogeneous and distributed.

For example, consider Ann, a 75-year-old living alone at home, but supported by her son Carl, assistant Dorothy and physician Britney. Britney has just diagnosed Ann with Alzheimer's disease, and suggests the following AAL service: '*measure Ann's weight on a weekly basis, wirelessly, via the smart environment facilities, and if there is a loss of more than one kilogram per week, then send an email to me (Britney) and also an SMS to Carl. Also, add an information entry to Dorothy's agenda and Ann's own ambient "info board"*'.

Implementing this rather simple yet illustrative AAL service involves a long-running process that iteratively, on a weekly basis, interacts wirelessly with a remote scale, maps raw data to actionable knowledge (working out 'if there is a loss of more than one kilogram'), and eventually launches coordinated actions that in turn involve

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heterogeneous interaction media (a mobile phone and an ambient 'info board'), multiple software components (for analysing weight trend, sending sms and email, adding an agenda entry), and several roles and relations (Ann the elderly woman, Britney her physician, Carl her son, and Dorothy her assistant).

AAL service protocols are expected to fill the significant gap that exists between sensing raw data on the one hand and orchestrating the involvement of networked artefacts in such a way as to deliver timely and meaningful services, on the other hand; this accounts for their extreme complexity.

1.2. The need to adapt AAL service protocols regularly

In the case of services to the elderly, the demand for individualised support is predominant, (changes in their condition and needs in the ageing process are permanent), and the diversity of cultures, capabilities, attitudes, values, and infrastructures a source of unlimited opportunities (variability in space).

This situation is an additional source of complexity, since the elderly's requirements for AAL services in time and space, e.g. at the European level, cannot simply be met by implementing sophisticated interaction and coordination protocols. The implementation approach, by design, allows the efficient and effective adaptation of those protocols to changing conditions and needs.

2. Streaming Environments as a Solution Approach

We propose *AAL service streaming environment*s, that is, AAL systems that externalise the implementation of their AAL service protocols. They allow runtime specification of AAL services using a declarative language (focusing on 'what' and not 'how'), and interpret those specifications to deliver the expected services.

For example, we propose to implement Ann's remote weight follow-up protocol by uploading at runtime a high-level and machine-understandable specification as follows:

```
1. measure wirelessly Ann’s weight on a weekly
   basis.
2. whenever there is a loss of more than one kg
   per week, then:
   a. send an email to Britney.
   b. send an SMS to Carl.
   c. add an information entry to Dorothy’s
      agenda.
   d. add an information entry to Ann’s
      ambient ‘info board'.
```

Figure 1: High-level specification of Ann’s remote weight follow-up protocol

Consequently, it becomes possible to adapt existing AAL services to new and changing conditions and needs quickly and cost-effectively, with well-identified expected outcomes, under the control of the specification language.

We additionally propose that AAL service protocol specification languages should be accessible to trained but non-technical end-users, e.g. caregivers. In effect, as we have discussed in more detail in [1], the uncertainty, diversity and change that underlie the development and maintenance of AAL systems and services may be perceived as an endless stream of unexpected new opportunities, and seized by applying participative design and empowering end-users to take an active part in the creation and maintenance of functionality that fits their very specific needs and conditions.

For example, we expect Ann’s AAL service streaming environment to allow Britney, and/or an assistant, to describe and deploy the required protocol themselves, in a close-to-natural description language like the one in Figure 1.

3. The Language Family Problem

Delivering individualised ICT-based support for the activities of daily life in the presence of dynamicity, diversity, and complexity is a highly challenging task. The current technology components provide only partial solutions. They propose to hard-code the AAL service protocols, which significantly reduces their (controlled) adaptation possibilities, and limit their maintenance to professional programmers, which increases the adaptation cost significantly.

More specifically, as Ann’s example shows, AAL service protocol specification languages and runtime must meet the following requirements:

- be feature-rich, and in particular allow AAL service protocols with sophisticated spatio-temporal and coordination relationships,
- hide the complexities related to the involvement of loosely-coupled, autonomous and heterogeneous components, as well as human actors, that

communicate asynchronously and coordinate actions based on data and control flow dependencies, and
- allow specifications that are human-readable and editable and are readily executable.

Additionally, domain-specificity is known to play a critical role in end-user accessibility [2]. Therefore, what is needed is indeed not a language but a framework for developing a family of such languages, each capturing the specificities of an application domain, usage mode, culture, etc.

4. AAS-Platform for AAL Service Streaming Environments

4.1. An object-oriented language framework

In the course of our studies during the past decade, and by extrapolating from concrete industrial experiences of creating sophisticated model authoring and model execution tools for non-technical end-users, we have designed and implemented an object-oriented framework [3] for end-user programming languages that meets the above requirements [4, 5].

In addition to addressing key technical issues related to the implementation of AAL service specification languages as enumerated in Section 3, this framework provides professional object-oriented programmers with extension points to adapt to the very specific needs of their applications the following aspects of the specification language that we propose by default:
- the default language syntax, i.e. the ‘nouns’ and ‘verbs’ of the language, as well as their composition and verification rules for constructing valid AAL service specifications,
- the default language semantics, i.e. the pre-built rules that govern the runtime behaviour of the language, in particular regarding (a) its execution model, (b) its policy for managing the heterogeneity and distribution of devices and protocols, and (c) its policy for managing and archiving the execution results (‘closed-loop’ management of objects' lifecycles),
- the default AAL service scheduling policy (currently under implementation), i.e. the rules that apply to the concurrent execution of multiple AAL services by the same streaming environment, and the management of long-running workflow activities,
- the default AAL service protocol specification editors (cf. http://afacms.com), i.e. the way in which those specifications are visually structured (graphical, tabular, textual, etc.) and rendered.
- the default packaging policy (‘builder’), i.e. the structure and content of a given AAL service streaming environment at deployment time.

4.2. A host software platform

The above language framework is today integrated into a host development environment, which provides a full set of advanced object-oriented and dynamic web application programming and deployment tools. We call the artefact that results from this integration AAS-Platform [6, 7]. AAS-Platform is further the reference implementation of our reference model for AAL service streaming environments as described in [8].

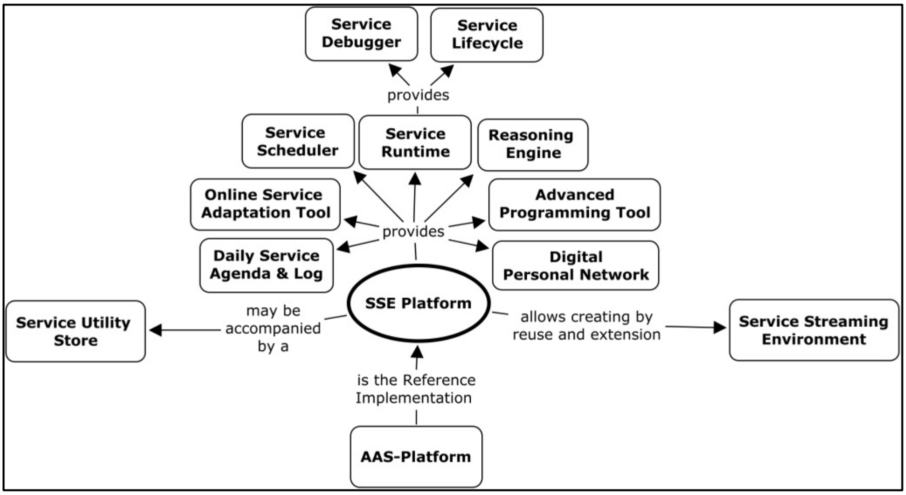

Figure 2: Infrastructure components provided by SSE Platforms

4.3. The Adaptive Object-Model architectural style

The architectural style of AAL service streaming environments (SSE) created by AAS-Platform is called Adaptive Object-Model [9]. As illustrated in figure 3, the sensing, classification, and action behaviour of AAL services is determined by specifications that are externalised and stored in a meta-data base called 'support logic', and interpreted by relevant components. Our reference architecture is described in more detail in [5, 10].

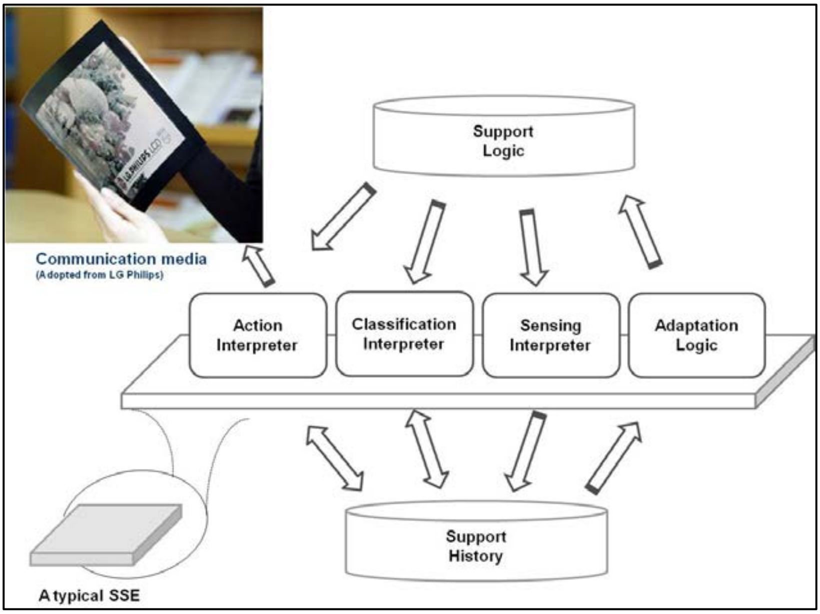

Figure 3: The Adaptive Object-Model architectural style of AAL service streaming environments

In standard architectures, however, the behaviour of those components is determined by rules that are hard-coded and 'trapped' inside the application boundaries (together with the application data), as explained in more detail in [11].

4.4. Application to develop AAL Service Communities

An AAL service community is typically composed of one elderly person, her/his primary, secondary, and tertiary care providers, and an AAL service streaming environment. We assume that the latter has the potential to support the sustainable development of AAL service communities by significantly improving the efficiency and effectiveness of their everyday activities, without adding excessive acquisition and maintenance costs.

The verification of this hypothesis will be subject to specific studies, in the context of a proof-of-concept project, which create a representative set of AAL service communities, and the collection and processing of metrics on their functioning and the role and impact of AAL service streaming environments. To this end, we are currently developing an AAL service streaming environment where members of the AAL service community are each provided with a digital calendar and can schedule daily AAL services defined by themselves by means of a high-level specification language.

5. Conclusions and Outlook

We have addressed end-users' requirements for individualised, affordable, usable and trustable AAL services through an object-oriented framework approach to develop domain-specific AAL service protocol languages by reuse and extension. This framework abstracts the common characteristics of those protocols (loosely coupled components, interacting asynchronously, and coordinating via data and control dependencies), and allows implementation of languages that are provided to final end-users as an online service. It is also part of a wider application-agnostic open software platform, AAS-Platform, that provides AAL service programmers with an extensive set of additional software engineering tools for developing 'container' applications that 'host' those languages.

AAS-Platform provides developers with a shared infrastructure for the step-by-step implementation and deployment of service streaming environments. With AAS-Platform, the problem of implementing AAL service streaming environments is reduced to that of developing a language and runtime for specifying and executing AAL services. With our language framework, called Dart, the problem of creating such languages is reduced to that of reusing existing code and extending it by means of well-identified extension points. AAS-Platform also allows the addition of extra tools by professional programmers using standard techniques and tools: for example, model-to-model and model-to-code transformation rules.

Additionally, our approach enforces the active participation of the end-users themselves in designing AAL services, which appears to be a more effective approach to the market in that it decentralises the AAL service design process, and empowers non-technical end-users to take an active part in the creation and adaptation of their own support solutions [12]. This approach offers a new way to seize the market development opportunities offered by the uncertainty, diversity, and change that underlie AAL services. Instead of deciding for the elderly, and imposing on them pre-built and rigid AAL services, we propose to provide them with relatively easy-to-use 'building blocks' so that they can smoothly tailor their own services, and adapt them alongside their ageing process to their changing conditions and needs.

Successful development and deployment of AAL service streaming environments for different application domains and cultures depend, however, on the availability of interoperable networked hardware and software resources, and, to some extent, the creation of an ecosystem of such external resource providers. We are currently in the process of selecting a set of networked resources and integrating them into AAS-Platform as a necessary step towards the development of real-life applications as proof-of-concept and proof-of-market and the progressively large-scale deployment of AAL service streaming environments.

Acknowledgements

This work has been funded by Ambient Activity Systems SARL, a technology start-up supported by the Luxembourg Ministry of Economy and Foreign Commerce. We would also like to acknowledge the insightful comments made by Gul Agha, Ralph Johnson and Jean-François Perrot on early versions of this paper, as well as the technical support of Goya Razavi.

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ICT SERVICES FOR PLEASANT AGING– SPES VIEW

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Abstract

The SPES project aims at transferring the original approach and results achieved in the implementation of an OLDES platform into four geographical contexts (Ferrara, Vienna, Brno and Kosice), focussing on the following target problem domains: dementia, mobility-challenged persons, respiratory problems and social exclusion. The main goal of the OLDES project was to create and test new technological solutions to improve the quality of life of older people, through the development of a very low-cost and easy to use care platform, designed to make life easier for older persons in their homes. The leading idea of the project was to offer a uniform technological solution which would provide all the features requested by providers of the social care systems, as well as those meeting the needs of various tele-health application scenarios. The feasibility of the OLDES concept was evaluated in patients with Congestive Heart Failure (CHF) and Type 2 diabetes mellitus.

Keywords: Ambient Assistive Living, Elderly, Online Social Network, Diabetes Mellitus, Congestive Heart Failure, User Centred Design, Remote Controller

1. Introduction

We live in times when the age structure of whole continents is significantly changing [1] and the percentage of the population that is aging is raising concerns throughout governments as well as for health insurance systems. Much hope is being targeted towards new assistive technologies that could offer reasonable help by developing reliable and low-cost technical tools with intuitive control, ready-to-improve

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effectiveness, interoperability and compatibility with national systems of health and social care. This problem has been addressed by the EU project OLDES (045282): “Older People’s e-services at home” (www.oldes.eu) that has been co-funded under the EU IST Programme during the period 2007–2010. The main goal of the OLDES project, which was undertaken by a consortium of 11 partners, was to create and test new technological solutions to improve the quality of life of older people, through the development of a very low-cost and easy to use care platform, designed to make life easier for older persons in their homes. The leading idea of the project was to offer a uniform technological solution which would provide all the features requested by providers of the social care systems as well as those meeting the needs of various tele-health application scenarios. The feasibility of the OLDES concept was evaluated in patients with Congestive Heart Failure (CHF) and Type 2 diabetes mellitus.

One of the distinguishing features of the OLDES system is that its service user (an older person) communicates with the system using a remote controller only – no keyboard is involved. This is the way OLDES tries to bypass the problem of technophobia, which has negative impact e.g. on perception of eHealth services among the potential senior users [2, 3]: the computer-based solution is masked by a TV screen and its remote controller that has been specially adapted for that purpose.

Firstly, we will describe the architecture, user-design and outcomes of the OLDES project. Secondly, we will describe the follow-up project SPES (Support Patients through E-services Solutions), funded by the Central Europe (ERDF) Programme, through which we will try to offer some new solutions for these issues, and which are being tested carefully in four pilot runs during the years 2011–2013. The new SPES system will be tested in other health and social conditions (e.g. asthma, cognitive impairments).

2. System architecture

The OLDES architecture consists of two main parts, namely the **local** and the **central hub,** as depicted in Figure 1. The Local Hub collects physiological data measured by sensors and enables the users to communicate together or with a tele-accompany operator through Voice-Over-IP. The information is collected by a low-cost laptop and sent via a secured Internet connection to the Central Hub. Each older person has his/her own health agenda stored in the Central Hub.

The Central Hub provides a unique and secure connection point to the OLDES central platform. It enables the physicians, GPs and tele-accompany members to access the system through easy-to-use and secure web portals. The elderly person continuously receives social–medical support from medical personnel, social workers and volunteers situated in the call centre. A healthy life style is promoted trough adequate scheduling of thematic entertainment channels. The architecture consists mainly of the following parts:

Low-cost computer: OLDES software is portable and does not rely on a specific hardware. It was tested and validated on different PC-based systems. For the pilot, an ASUS eeeBOX was used and deployed in the older persons' homes.

Remote Control: OLDES substituted the classical keyboard of a common notebook or laptop with a remote controller in order to simplify interaction with the system.

Medical Devices: The following devices and sensors have been tested in the design and development of the OLDES platform: a **s**phygmomanometer for measurement of blood pressure, a belt for electrocardiogram (ECG) monitoring, a pulse oximeter for monitoring the oxygen saturation of the patient's blood, a LifeScan glucometer for measurements of glucose levels, together with scales for body weight measurement and an interactive scale for daily food intake records.

Supportive Home Appliances: The diabetes pilot project offers the users the possibility to control their diet, namely their input of saccharids. For that purpose, there is set of kitchen scales wirelessly connected to the computer. The user selects the type of food that is currently on the scales using the remote controller to find out its nutritional value.

Graphical User Interface (GUI) Client: The GUI framework is implemented as a standard client–server approach. GUI Client, which runs on a low-cost computer, connects to the GUI service server to fetch resources and dialogue pages – see Figure 3.

Graphical User Interface Server: The server part is implemented in PHP and is responsible for handling client requests and generating GUI pages. The GUI pages are generated dynamically by the server on the basis of data and configurations stored in a database. Due to this feature the look and feel of GUI is customisable for each user.

Voice-Over-IP Server: The OLDES platform offers communication services adapted to older persons' needs and is based on modern Voice-Over-IP communication technologies. In order to implement this functionality the open-source Asterisk PBX server was selected.

Clinical Information Server: This server receives, stores and analyses the medical data sent by the local hubs. An advanced database, called the Electronic Health and Social Record, was designed and implemented in order to store all the data.

Central Server: the Hub works as the connection point between the home systems, the carers and clinicians or e-Care operators, and service providers and maintainers.

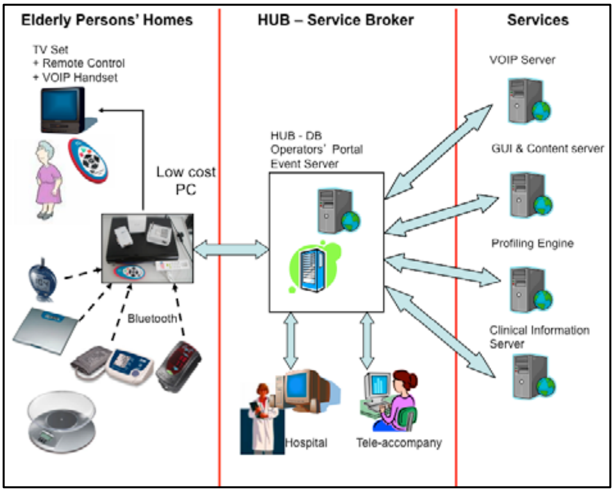


Figure 1. OLDES architecture

3. Inclusive Design

The user interface has to meet the requirements of its users and of the task to be performed. It is important not to overwhelm the user with too much detail while providing him/her with all necessary information. To find the proper level, we have first applied paper prototyping [4] with the clear goal of designing a suitable user-interface for older persons suffering from diabetes. The user-interface guided the user through all the necessary steps that he or she experienced when trying to accomplish tasks, e.g. measurement of glucose levels, weight, blood pressure or choice of appropriate food, according to the recommended amount of saccharine. The paper-prototyping testing conclusions clearly influenced the software prototype design.

The user designed the user-interface him or herself according to their point of view. Several mock-ups had been prepared in advance as main menu and sub-menus, icons, and titles of the menus. If the user suggested any issue and the prepared components were not ready, then coloured papers were used as substitutes for the issues such as menus, the value of glycaemia, or a picture – see Figure 2a. Secondly, the software prototyping approach was applied. During the software prototype test sessions in the usability laboratory, the user was seated in the testing room alongside the moderator who was guiding him or her during the usability test. The moderator tried to intervene as little as possible, being expected to give clues and to move the user to the next stage only if the user was apparently lost or confused. All the user's actions were monitored in the observer room by means of two video cameras (front and rear view) and audio recording – see Figure 2b. Even inexperienced computer users were able to accomplish the set of defined tasks in a 30 minutes period. The experienced users took 10–15 minutes to accomplish the requested tasks.

Figure 2. Prototyping sessions: a) paper prototyping, b) software prototyping

4. Pilots

4.1 The Bologna's pilot

The Bologna's pilot aimed at testing the OLDES platform in a cohort of 100 older persons. Further to the tele-accompany services being provided to the whole range of persons, 10 suffering from CHF have been included in the cardiovascular pilot, where the tele-accompany component was complemented by remote monitoring through sensors measuring selected physiological parameters (body weight, blood pressure, blood oxygen saturation, ECG).

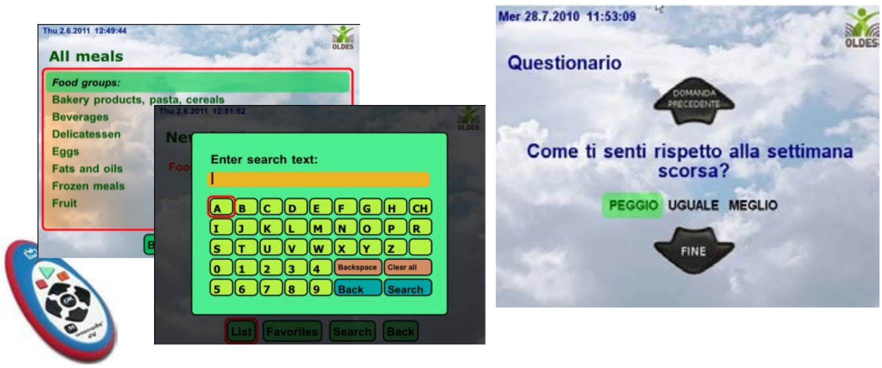
The Pilot Study in Bologna tested the OLDES telemedicine platform in 10 subjects with CHF. All patients met the inclusion criteria of the Telemedicine Pilot Study: (i) known diagnosis of congestive heart failure, (ii) age > 65 years, and (iii) clinical and therapeutic stabilisation for at least three weeks.

The telemedicine system tested in Bologna also included the digital administration of a clinical questionnaire designed on the basis of clinical questions which patients are usually asked to answer during their outpatient visits – see Figure 3b.

4.2 Prague's pilot

The Prague's pilot focused on older persons suffering from Type 2 diabetes mellitus (T2DM). Diabetes mellitus is a chronic metabolic disorder characterised by increased glucose levels due to insulin secretion deficiency and decreased sensitivity of peripheral tissues to effects of insulin, which can ultimately lead to development of acute (hypoglycaemia, hyperglycaemia) and long-term complications (cardiovascular, cerebrovascular, renal, ophthalmic). In this context, the project offered the users the possibility to control their diet, allowing the carer or the physician to monitor selected physiological functions and glucose excursions in an online fashion. Diet is a critical aspect of diabetic compensation since patients are required to strictly adhere to predefined diet composition and energy intake. Dietary adherence is a major problem in most patients with T2DM, and in the elderly in particular. A programmable interactive scale incorporated into the OLDES platform is able to calculate the exact amount of energy and nutrients encompassed in a particular portion of food – see Figure 3a. The platform's memory stores data on calories, saccharides, proteins and lipids ingested throughout the day and compares this to the maximal daily doses recommended for the particular person. This process has been implemented through the use of wireless scales installed at patients' home where the food is weighed and assessed with regard to its nutritional value. As cardiovascular complications are the most common cause of death in diabetic patients, blood pressure measurement, as the simplest cardiovascular parameter, was also adopted into the system. Patients were asked to measure their body weight once a day, and blood pressure and glucose level three times per day. After the obtained data are sent into the OLDES platform, the system evaluates them using an appropriate algorithm. The system can raise medical alarms if necessary or point out some extreme values to the physician who is then able to make adequate recommendations.

All patients involved in both pilots agreed that the OLDES system was user-friendly. The most appreciated part of the system was the smart control of the GUI using the remote controller, and easy-to-use measurements of vital physiological parameters. The obtained tele-medical results are represented by a set of curves depicting the time course of selected vital parameters and by tables summarising food consumption with exact data on meal types and their energy and macronutrient intake.



a) b)

Figure 3. Graphical and tangible user interface with the remote controller: a) remote controller used for controlling graphical user interface and Prague pilot user interface – food item selection; and b) Bologna pilot user interface – example of questionnaire (How did you feel last week? – better, no change, worse).

5. Results and Conclusions

Participation in the OLDES project stimulated older persons to use ICT instruments and solutions, enriched their skills and improved their opportunities to interact in the modern communication world. The project proved the feasibility of daily use of a low-cost home access point to make various services available, to support social interaction and finally to manage efficiently some problems of chronic diseases (diabetes and chronic heart failure) through cooperation between social and medical services using monitoring of physiological parameters. Experience of the pilot runs in several dozens of households pointed to the following directions for further research and development:

a) The OLDES system limited the **control interface** to the remote controller (see Figure 3a). This device was very well accepted by some users, while several complained about it. It seems that a touch screen could accommodate the requirements of those who had problems with the remote controller. In the ideal case, there should be available some choice of means of control and user interface to accommodate the needs of different users.
b) The users in the OLDES system interacted with several medical devices. Some of them required very simple interaction, e.g. pressing a button to start measurement or transferring data. Despite the easy one-step action, some users experienced difficulties, resulting in data losses. In future, medical devices should operate automatically without user control or interaction in order to ensure **regular monitoring** of patient health-status.
c) The OLDES system was designed to be used in the homes/flats of its target users. But there are some target groups operating in a richer range – these users would certainly highly benefit from a mobile application. Can the OLDES solution be generalised to a **mobile setting**?

The follow-up project SPES will try to offer some new solutions for these issues, and will allow them to be tested carefully in four pilot runs during the years 2011–2013. The original OLDES system is currently being adapted for use by mobile users and with alternative control means. The new SPES system will be tested for other health conditions (e.g. asthma or dementia). Moreover, SPES will pay particular attention to the problems of the intersection between technology and social inclusion, as mentioned in 5c, above. It will enable us to review the aims of our planned pilots in several new locations, which are expected to work with each user for a medium time span of at least several weeks.

The Ferrara pilot (Italy) is targeted to patients affected by chronic respiratory failure, requiring long-term oxygen therapy and non-invasive mechanical ventilation, and who are already monitored by pneumologists for periodical clinical controls. The aim is to provide patients suffering from breathing problems with a system that can remotely monitor their health status using a saturimeter and several other non-invasive medical devices, in order to enable more efficient use of medical aids and a more efficient organisation of the healthcare service provided by medical staff. A complementary medical web application will allow clinicians and all the other stakeholders involved to access patients' data and report clinical considerations.

The Vienna pilot (Austria) endeavours to find tailor-made solutions for persons with dementia who face health risks and who are prone to accidents because they tend to get lost on the street, etc. Such persons often have to move to inpatient care, although they would prefer to continue their self-determined lives in their private homes. Their families are overburdened by constantly having to look after their disoriented relatives.

Another user group requiring a mobile application will be that of **the Boskovice pilot** (Czech Republic), which will be focused on 40 mobility-impaired clients of the non-governmental organisation DEEP. DEEP's clients are often illiterate in the field of assistive devices and monitoring services, including the e-health concept. Therefore, as the first step, courses and appropriate training will be provided in a range of registered social services, motivating seniors and disabled persons in the field of communication services, education, social and professional integration. The DEEP team will select 40 clients to take part in the SPES pilot testing of services based on monitoring through sensors and detectors.

The Kosice pilot (Slovakia) will be devoted to problems related to the social aspects of technology development, as described in 5c above. The main aim will be to ensure means to improve social inclusion of older people through suitable ICT solutions designed and developed within the SPES project. The older persons will be able to enrich their daily routine by various communication and social features for spending leisure time or mediating psychological support. The offered solution will be based on detailed analyses of existing opportunities, requirements and expectations from the target group of seniors, who will be offered an opportunity to remain in contact with their relatives, neighbours or other people with similar hobbies or health problems.

Acknowledgments

The project was supported by the Ministry of Education, Youth and Sport of the Czech Republic with grant no. MSM6840770012, entitled "Transdisciplinary Research in Biomedical Engineering II", and by SPES: Support Patients through E-services Solutions - the CENTRAL EUROPE 3CE286P2 programme.

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THE CAPMOUSE PROJECT

Tomas Brusell[1]

1. Partners

1. **Brusell Dental AS** – coordinator of the project and provider of the patented CapMouse sensor technology (Norway)
2. **National Pensioners' Organisation (PRO)** - Sweden's largest organisation for the elderly
3. **HMC International NV** (member of the Permobil Group) - a Belgian technology company developing and marketing handicap aid technologies
4. **Lots Design I Göteborg AB** – Swedish industrial design company
5. **Stinct AB** (Sweden) – additional industrial design competence

2. Funding, timing & project status

The CapMouse project was selected for funding by the AAL Joint Programme in 2008 and is funded by the national agencies of the respective partners: IWT - The Belgian/Flanders Innovation Agency; Vinnova - Sweden's Innovation Agency; Research Counsel of Norway - Norwegian national innovation agency.

The project ran from 1 June 2009 to 31 May 2012 (including the six-month extension requested from AAL JP at the beginning of 2011). The total project budget was over 1 million EUR and support was 50%.

Compared with the original proposal there have been two major deviations: the development of a working sensor array has proven more costly and more time-consuming than anticipated. Concerning timing, we requested a six-month extension to the project period (approved in 2011). Concerning funding, there was a shift of budget between some partners as a result of an updated task division and partners BD, HMC and LOTS have invested more resources in the project than planned, covering the excess from their internal reserves.

In September 2011 we finally succeeded in producing commercially a well-working sensor array that has the potential to pass all necessary testing. Therefore we are optimistic about having a working prototype that has been tested both technically and from an end user perspective.

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[1] Brusell Dental AS – coordinator of the project and provider of the patented CapMouse sensor technology (Norway)

3. Background and project status

The goal of the Ambient Assisted Living (AAL) Joint Programme project **CAPMOUSE was the development of a hands-free tongue controlled external input device *CapMouse* for the handicapped/elderly and its integration with an existing mobile device - the *Octopus*** – an innovative control box for ICT applications manufactured by project partner HMC International (www.hmc-products.com) for the disabled users of Permobil wheelchairs and handicap aid products (figure 1).

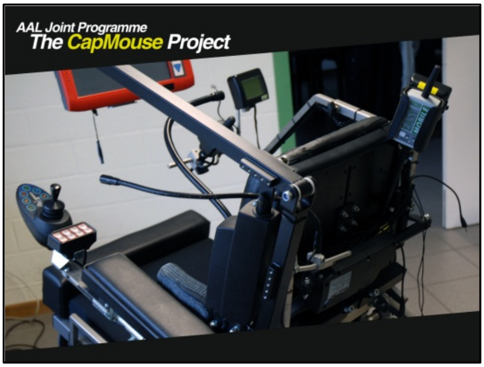

Figure 1. The need for hands-free solutions is obvious and Hands Free Oral Control will enhance the integration of disabled persons in the modern ICT world of social media and online communication

For the disabled elderly with physical impairments it is a challenge to double click on a standard computer mouse and to move the mouse in a well-controlled manner. It is also a challenge to point at the screen age-related illnesses, e.g. rheumatism, affect the mobility of the upper extremities. The *CapMouse* human interface device will be an alternative to the existing standard input devices for a diversity of user groups, including the elderly and elderly disabled, who will be able to control any ICT equipment via e.g. *Octopus* truly hands free! The initial target group for *CapMouse* is the elderly and the elderly/handicapped who contributed to the user requirements collection and who will also participate in the user testing of the product in different stages.

Technologically, the *CapMouse* device is based on novel capacitive sensors developed (patent: PCT/SE2008/000531) by the coordinator Brusell Dental AS (www.brusell-dental.com) in cooperation with HMC International. A single sensor provides three different commands and five sensors in an array make a multitude of commands possible. The fact that it is controlled by tongue in a non-invasive way together with appropriate software coding makes the *CapMouse* an attractive option among input devices for the control of the *Octopus*. In addition, the *CapMouse* will, eventually, be a Plug & Play compatible with PC/MAC, iPad and smartphones.

4. Development

The development of the *CapMouse* user interface can be broken down into the following major stages: (a) single sensor technology developed into a functional sensor array and its testing; (b) suitable physical design development including user testing for design and functionality; (c) integration and application software development including prototyping and user testing for applications.

The first task is the **technology design** that has to be carried out by mainly BD and HMC. As a result of several rounds of development-testing, redevelopment and retesting, the major breakthrough was achieved in September 2011: the five-sensor array hardware is finally functional and can be prepared for EMC and EMI testing, as well as for end-user testing for calibration purposes. In parallel a datalogger software was developed. The next round of end-user testing took place in October-November 2011 when we expected to develop algorithms that enabled auto-calibration and application software (firmware) development. This was in turn tested on end-users in spring 2011 (figure 2).

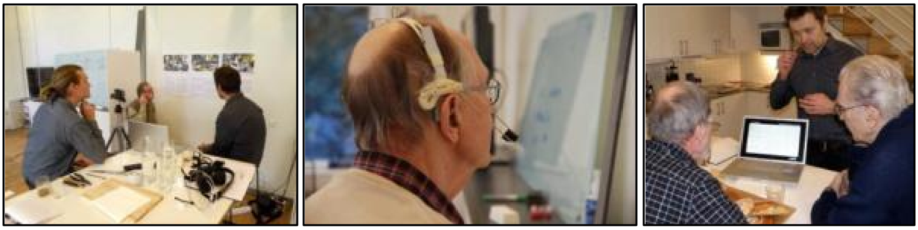

Figure 2. Extensive testing together with end-users and extraction of end-user requirements is crucial in the AAL JP CapMouse Project

The second task is the **physical design.** To be able to serve the needs of the targeted initial market (elderly/handicapped), the design of the headset is crucial. Therefore the consortium includes a professional industrial design company LOTS Design i Göteborg AB (www.lotsdesign.se) and PRO (www.pro.se) - an umbrella organization of the elderly. Their task is to deliver a custom industrial design and ensure that it is tested and accepted by the end-users once it is on the market.

5. End-users with different requirements

The combined effort of the five partners will result in a working prototype of the *CapMouse* compatible with the *Octopus* and tested by end-users, technically ready to be handed over to any production company for implementation to production lines and commercialised thereafter.

6. Discussion and conclusion

The crucial testing phase determined the success of the AAL JP CapMouse Project. EMC testing and end-user testing of the functionality and robustness of the sensor array generated feedback for the finishing of the prototype and CAD documents prepared for the industrialisation as blueprints for production. The testing phase ended 1 Q 2012.

A parallel process ran; Lots Design finished the headset in accordance with end-user requirements refined in cooperation with PRO. Brusell Dental delivered the sensor technology and HMC International integrated it with Octopus ICT. Artec Design (www.artecdesign.ee), Tallinn, Estonia, will be subcontracted to Brusell Dental as a manufacturer of the sensor.

The main IP consists of the EU and US patent owned by the Brusell Communications Group (Brusell Communications is the mother company of Brusell Dental):
http://www.wipo.int/patentscope/search/en/WO2009078776

The partners agreed upon the sharing of the IP rights according to the Consortia Agreement and negotiated the final specific IP agreements for the most beneficial outcome for all partners of the AAL JP CapMouse Project before the end of the project in 2Q 2012.

TRACK D RATIONALE

Future Call Topics[1]

The following four calls have so far been published by the AAL Joint Programme:

- Call 1 called for proposals related to “Management of Chronic Health Conditions”
- Call 2 focused on “ICT-based Solutions in Advancing Social Interaction of Elderly People”
- Call 3 focused on ”ICT-based Solutions for Advancement of Older Persons’ Independence and Participation in the “Self-serve Society”
- Call 4 had a theme of “ICT based solutions for Advancement of Older Persons’ Mobility”.

The main aspect of Track D is to offer to the AAL Community and various stakeholder groups an opportunity to take part in the preparation of future call topics at the AAL Forum. The most important core elements of the AAL Joint Programme, starting from specific user needs, will be discussed. The results of Track D sessions will be used as input to the future development of the AAL Joint Programme. The results of the session are envisaged to form an essential input for the development of the programme.

Session D1

The concept of this session revolves around a “speed dating” event, as described below. Four possible future call themes will be “dated” by the participants. For each theme, a moderator and a notetaker will present the theme and followed by a specific structure of questions for discussion. The participants may raise additional questions on the theme. After 15 minutes, the participants will move to the next theme.

- Theme 1: Information/Learning/User Interfaces
- Theme 2: Home Care - informal and professional care (moderator: Mrs Viviane Von Döllen)
- Theme 3: Prevention (moderator: Martin Jaekel)
- Theme 4: AAL at Work (moderator: Karina Marcus)

[1] AAL Forum 2011, OnSite Guide and Programme

Session D2

Life-long learning is a requirement in a rapidly changing environment as well as to keep up with technological developments. In particular, older adults need to be supported in keeping up to date with developments to remain included in the society. Interfaces play a major role in accessing new solutions. Important aspects are:

- Mobilizing, maintaining and sharing resources that older people acquire in terms of competences, experiences and knowledge
- Contributions of older people to the society, including across the generations as well as to their peers (teach, inform, help and support others)
- Enriching their own daily lives

Session D3

Whilst professional care services are indispensible in many cases, family care is the predominant model of support for older people today. However, demographic changes and individualized family structures will require new concepts of care, and will therefore provide opportunities for new technological solutions in areas such:

- Mobility within home, especially getting up from the bed, or a chair Personal hygiene
- Daily meals / sufficient dietary nutrition
- Access to toilet / incontinence
- Getting dressed, especially putting on socks and shoes

Session D4

The interrelated effects of increasing chronic conditions with the ageing of population are compelling policy makers to change the paradigm of healthcare and care. Primary prevention through individualisation of responsibilities and activities with “health” as part of daily life is increasingly becoming the focus of new health concepts. With this convergence of healthcare and wellness, new commercial opportunities are emerging in the organised health market. An effective integration of user and business concepts is key to realising the new opportunities.

Primary prevention comprises two primary areas of policies:

1. Lifestyle-related policies:
    - promoting and supporting physical activities and healthy nutrition (Overweight and obesity: main causes of cardio-vascular diseases, diabetes, relevant for osteoporosis and Alzheimer)
    - the importance of social inclusion and mental activities for many diseases, especially depressions and mental disorders

2. Setting-oriented policies
   - provision of information about diseases and risk factors
   - regular health checks and counseling
   - city level activities, e.g. provision of physical training facilities, informal groups, voluntary organisations and pilot projects for comprehensive solutions

This session will focus on the following topics:
- Emerging consumer markets for prevention and related devices and services
- Integration of local service organisations into product/services and system solutions

Connecting all stakeholders in the value chain to project consortium.

Session D5

"AAL at Work" has to be a part of employment and workplace-related policies to meet the main objectives of companies, trade unions and governments. This could be achieved by:
- increasing productivity and competitiveness through sustaining and increasing the competences of senior workforce
- maintaining the security and improving the health of the workforce
- learning and training for senior workforce to maintain competences
- improving the compatibility between work and private life taking into account cross generations needs

Technology development and systems solutions have to be adapted to existing structures in the workplace and work organisation; they have to be really "assistive", which imposes a specific challenge on developers. It is therefore advisable to focus this session on one of the following specific application areas:
- The new workplace
- The "knowledge organisation"
- New concepts for learning and training of senior workforce
- Sustaining health at work
- Family carers: Cross generation compatibility of job and care
- The health and social care sector as a specific target for AAL

The Track was well accepted: all sessions were joined by nearly 50 participants.

TRACK D NOTES

SESSION D1 – OPEN SESSION AAL TOPICS

Hartmut Strese[1]

Rationale

The idea was to organize a kind of speed-dating event: four possible future call themes were "dated" by the participants. For each theme a moderator and a notetaker were responsible. They briefly presented the theme by following specific questions or a template and subsequently the participants could ask questions as well as discuss the topic. After 15 minutes the participants moved to the next theme.

- Theme 1 **Information/Learning/User Interfaces**; moderator: Axel Sigmund (VDI/VDE Innovation + Technik GmbH, Berlin, DE); notetakers: Daniel Egloff (CH) and Franziska Schätzlein (User Interface Design GmbH, DE)
- Theme 2 **Home Care - informal and professional care**; moderator: Viviane Von Döllen (Stëftung Hëllef Doheem, LU); notetakers: Pekka Kahri (TEKES, FI) and Claude Lagoda (CRP Henri Tudor, LU)
- Theme 3 **Prevention**; moderator: Martin Jaekel (CMU AALA, BE); notetaker: Birgid Eberhardt (VDE, DE)
- Theme 4 **AAL at Work**; moderator: Karina Marcus (CMU AALA, BE); notetaker: Camelia Dogaru (CMU AALA, BE)

The session was visited by about 50 participants, who were distributed at four tables and changed correspondingly. The results of these discussions, taken by notetakers and discussed by the chairs and the track leader, are summarized under the following thematic sessions.

[1] VDI/VDE Innovation + Technik GmbH, Berlin, DE

SESSION D2 – INFORMATION, LEARNING, INTERFACES

Daniel Egloff, Franziska Schätzlein[1]

Outcomes of the sessions:

- **Acceptance through simplicity**: This generation of the elderly demands *easy-to-use* solutions (user interfaces like TVs, touchpads etc.); even for technicians, the technology of today (user interfaces etc.) is too difficult to use. Keep it simple: "3 buttons only". The device should learn how it's being used, the user should not need to learn how to use it. Example of a dictation device which offers either 200 options or (reduced) only 5 options: 95% of the persons are happy with only having 5 options, albeit not identical options. A service is needed to configure a device to meet individual needs (relatives or qualified specialists).
- **What kind of learning**? It is not necessarily all about technology and ICT, just basic know-how. The next generation will be more at ease with the use of technology, but technology changes over time: Note that even if a 60-year-old is familiar with the ICT of today, it does not mean he/she will be familiar with the technology present in 20 years (when the person is 80).
- **New forms of Internet access**: It is not necessary to teach *all* people how to "surf" the Internet, not "learning ICT", but "learning to write mails"; new forms of using the Internet (without having to "access" it actively) are needed.
- **Lifelong learning**: Media courses, Facebook courses, etc. -> society expects *continuous* lifelong learning. Seniors have different cultural and educational backgrounds (technology may *support* the culture in a society – Finland is not like Austria in the meaning of this cultural behaviour). Problematic: people with low education and immigrants will have more difficulties in learning; less-educated/immigrants are hard to reach.
- **Make learning solutions realistic**: The solutions must acknowledge the special situation of the older generation, including the consequences of old age (forgetfulness, the fear of losing control). Frustration is not a good means to learn ICT. What user group do we want to reach? Teaching is important (by informal carers or by others). Quality criteria for good teaching are needed.

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[1] User Interface Design GmbH, DE

- **Open university approach** in learning and teaching: a *community* who wants to learn *and* teach (in a combination of virtual meetings and real-life settings). How to support this with ICT (e-learning, etc.)? Research should address the ways in which people share their knowledge.
- **E-learning solutions to teach, not only to learn**: E-learning solutions that easily allow older people to publish their knowledge. Currently, e-learning authoring tools are a usability nightmare.
- **Two separate approaches**: Including new functions in familiar devices vs. creating totally new devices.
- **Acceptance**: Never try to convince a 90-year-old that he/she HAS to do something -> the advantage, the need or better the fun of it must be obvious to them.
- **Increase the credibility of information:** A *bridge* between old and new information delivery methods (Wikipedia/Google vs. the encyclopaedia model).
- Taking into account that **older people think and act differently** and may have other needs (for example: old habits like writing a letter, in the context of email). It's harder with age to decide which information is relevant and ignore irrelevant information > learning material must support seniors to focus on the relevant parts.
- **Learning in the context of retraining/getting back to work.**
- **"Forcing" vs. "motivating":** Putting the elderly into situations where they *have* to learn (like paying bills online) because there are no alternatives vs. using motivation to do so. How can ICT promote/awaken curiosity?
- **Different settings for learning:** At home, at universities for seniors, elsewhere. Learning is *easier* when it happens *within a known community* (within a familiar community).
- **New user interfaces**: User interfaces (types/categories) play an important role in learning; future developments may lower the barrier for the elderly considerably. What could future interfaces be? Possible interface developments: multi-touch and haptic interfaces, non-contact interfaces (speech recognition, gesture and pose recognition as with Kinect); augmented reality, brain-computer interfaces.
- **Devices**: We need to rethink what a device is! Mobile phones, flatscreens, smart TVs. That's too restrictive. Next step: "Intelligent social artefacts", including RFID sensing, etc. Move the interaction to the "ambiance"! Such devices are much less intimidating. Make the environment *useful* for the older person! E.g. it is a problem when seniors are not used to ICT: there are more services like private banking and the elderly cannot access them then.
- **Universal design**? The use of *the same* device by adapting to user and age groups, *personalizing*? How much technical support do seniors accept with how much personal communication?

- **How to deal with the problem?** Elderly people don't like to go back to the classroom, but lack interconnection, they have nowhere to go for learning, no social network (when learning at home, there is also no interconnection). Loneliness of elderly people: they want to meet people and lose friends when they get older (die, ill), they need to find new friends (which is really difficult).
- **Future vision**: Elderly people will meet in groups for learning; a new group means new potential friends, saying "I'm still here". Having fun, game, safety, relax are feelings we have when we are together with friends, therefore people have to get a safety feeling in those groups of learning first.

Ideas for next call:
- Analyse ways to motivate seniors for learning ICT
- Why should people do lifelong learning?
- How to reach the people?
- How to transport the benefit to the elderly people?
- What is the surplus of ICT?
- Teacher should not be seen as/behave like a teacher because seniors won't accept
- What to do with the technology we have so that seniors really use it? Or should we see the user first and then we need to adapt the technology?
- Challenge: building communities for learning of elderly people
- It was suggested that the issue of user interfaces could also be addressed across different topical areas. Standardized interfaces for better use-friendliness for the elderly have also been discussed.

Tatjana Prattes

There is more work-related learning as a key competency necessary. They offer ICT courses for seniors and there is a rising demand. Aim of the project "Learn and Network" is to teach computer literacy on a special platform (Web 2.0). They want to have 600 users to be aught. Courses are not free, but cost 130 € each (4 times two hours, 12 participants in the course). Challenges for the project are:
- Motivate elderly persons
- Give seniors basic ICT know-how
- Seniors have different cultural and educational backgrounds

Future aims:
- Need to convince seniors of the value of ICT
- Connect seniors (social networking)
- Develop quality criteria for learning of seniors
- Develop materials and concepts for learning for elderly

What was learned? Frustration is not a good goal to learn ICT, so first try to find out what people want. Make clear who the target users are; "the elderly" does not exist. People with low education and immigrants will have more difficulties in learning;

less-educated/immigrants are hard to reach. Also a problem when seniors are not used to ICT: there are more services like private banking which the elderly cannot access then.

How guide people to learn?
There was a lively discussion, questions were e.g. :Is there already a business case for the learning courses? Yes, it costs. Is there a platform after the course where the seniors can stay connected? That’s not clear in the project so far; a platform with learning materials and social networking would be interesting.

Aliaksei Andrushevich

Learn@Home is an interaction and training framework with multiple UIs for elderly persons. It is harder with age to decide which information is relevant and ignore irrelevant information, therefore learning material must support the seniors to focus on the relevant parts. Multimedia format is more efficient for learning, esp. multimodal learning methods support learning of the seniors. How to motivate the seniors? Barriers for learning of elderly are (e.g.): poor health, cost of transportation, absence of a companion, lack of information about what is available, fear of the unknown, fear of competition with younger ones or fear of exposure of the background. Train seniors at home through the usage of multimedia technologies, the smart home is the interface to the world!

There is a need to validate interfaces to be used for learning of elderly, e.g.:

- Multi-touch and haptic interfaces
- Speech recognition
- Gesture and pose recognition (Kinect)
- Augmented reality
- Brain-computer interfaces

The goal is to create an integrated and networked solution where users with different education are motivated for lifelong learning.

In the discussion these needs were stated: Give seniors the necessity to use ICT (e.g. private banking), then it will work. But there was also another opinion: Necessity is not a good motivation. Motivation of seniors for learning is difficult, they don’t want more lifelong learning – so get them to want to learn. People just want to use things, they do not need to know how it works. So we have to learn how the user perceives it, which means the senior should not deal with “learning ICT”, but “learning writing mails”.

Hein de Graaf

Elderly people don't like to go back to the classroom. They often lack interconnection, so when learning at home, there is also no interconnection. There is a general loneliness of elderly people: they want to meet people and lose friends when they get older (die, ill) and need to find new friends.

Future vision is: Elderly people will meet in groups for learning, because a new group means new potential friends, saying "I'm still here". So start with physical meetings and then move to virtual meetings. Problem is that elderly people have nowhere to go for learning, no social network. Statistics say you need to meet 150 people to make 1-2 friends in the end and 20 people you meet frequently. In general, people are in the community because they have a shared passion.

Having fun, game, safety, relax are feelings we have when we are together with friends. So we have to get a feeling of safety in those groups of learning first and that's why they should start with really meeting people physically. How much technical support do seniors accept for their personal communication?

SESSION D3 – HOME CARE (INFORMAL AND PROFESSIONAL CARE)

Pekka Kahri[1], Claude Lagoda[2]

Outcomes:

- Technologies and services need to be based on real user needs, as seen by the user and not just the professionals
- End-users must be involved at all stages of development and not just on an ad hoc basis or just for testing. They need to be encouraged to "participate" rather than just be consulted
- Funding issues need to be reviewed so as to ensure end-user involvement
- End-user "fears" and reluctance to use certain technologies need to be addressed
- A distinction has to be made between the Caregiver's needs and the Caretaker's needs, they are not necessarily the same
- Formal and informal Caregivers need to be treated separately, as they have different needs and requirements
- The reluctance of formal and informal Caregivers to use technologies needs to be handled separately (e.g. formal Caregivers may fear losing their jobs and being replaced by robots, while informal Caregivers may just have problems understanding and using the technology as they are elderly themselves)
- Technologies and services need to be empowering, helping users to "do things themselves" in a better or easier way, rather than "doing for them"
- Technologies and services should be progressively adaptable so as to adjust to changing needs of the users (i.e. health deterioration, increasing impairments and disabilities)
- Standards and interoperability are important, open platforms or open source should be preferred in order to allow various product and service providers to plug into the same systems
- New forms of financing or integrating services will need to be developed in order to facilitate the move from R&D to business exploitation

[1] TEKES, FI
[2] CRP Henri Tudor, LU

- With regards to future calls and home care, the concluding statement was that maybe the call definition could ask for solutions or outcomes instead of defining the call topic in high detail (compare to e.g. “Solution for clean hands”, “Reduction of false alarms by X%”). It was also noted that palliative care and end-of-life services at home and domiciliary psychiatry are areas remaining to be more fully addressed.

Rolf Kistler

He spoke about the iHomeLab in Switzerland and in particular their SenCARE project. The iHomeLab is the Swiss think tank and research laboratory for building intelligence. Energy efficiency, comfort and safety are the key aspects. Special attention is given to the issue of ambient assisted living. The iHomeLab is also a network platform where the latest results of joint venture research projects are presented and discussed.

The research at iHomeLab focuses on end-users and communication, science and technology and business and market. The SenCARE project (SErvice Network Connecting Ambulant carers to RElatives) is end-user centric and helps to provide a major link between caretakers and caregivers in Switzerland. This project is based on extensive interviews with end-users, caretakers and caregivers alike so as to ensure that both sets of needs are covered adequately.

The key issue raised by the caretakers was the need for technologies to be simple, self-explanatory and intuitive. On the other hand, caregivers were more concerned about ethical and financial issues. Caregivers were anxious to ensure that the technologies would be used as a means to support them and not to control them. The machines that are designed should not aim to replace the caregivers but aim to make their work easier and more efficient so as to increase the time they have with caretakers.

The research undertaken by iHomeLab also identified the need for ensuring that assistive technologies are usable by all informal carers, including those that act as volunteers, and that additional services are developed to stimulate the deployment of such volunteer caregivers. Business and funding models need to be adjusted too.

Margaret Ellis

She started with some very challenging remarks about the developments in assistive technologies over the past 20 years. She challenged the R&D communities to stop re-researching the same aspects over and over again, and to start using the excellent research that has already been undertaken and to build on it. She pointed out that a great number of research results are already published on official EU web pages. Some that she named as examples were the ETSI standards (existing measurements/protocols/standards) and the guide for good practice: CEN Guide 6.

Margaret Ellis remarked that time is of the essence and referred to research undertaken in Scotland which took current care models with current caregiver/caretaker ratios and correlated them to the official projections of population changes over the next decades. The research concluded that in 25 years time, unless major changes are introduced in the way care is delivered, Scotland will face the impossible situation where all Scottish school leavers will need to get involved in care-giving in order to satisfy future needs. Thus, telemonitoring, telecare, telemedicine and assistive technologies of all forms will be needed as they will not only save a lot of money but also enable the necessary changes in the way care and related services are delivered.

For this to happen effectively, the roles and attitudes of all stakeholders (including politicians) will need to change. Research and business must develop hand in hand. End-users must "participate" at all stages and not just be consulted from time to time. All involved need to communicate better, build on existing research, be aware of the costs of doing things but also the costs of not doing things. And it is important to have good examples. In fact, the motto should be that "professionals" should stand on the shoulder of giants (the users).

Massimiliano Malavasi

He presented the work done by AIAS Bologna, an organization whose aims are to ensure and promote the right of people with disabilities and of their families to a life that is happy and an integrated part of the community. The AIAS Bologna has investigated ways of reaching end-users, assessing their needs, and different ways to deliver services to them.

A number of case studies were presented. They concluded that technology and service development needs to become more "solution oriented" and service delivery models should become more end-user centric. The best results were achieved when a multilevel network had been established and work was undertaken by multidisciplinary teams, which is very efficient although somewhat expensive. Good results are achieved in some companies by combining the informal care of children with that of older relatives.

One of the main remaining challenges will be to ensure that future service delivery models will become more cost-effective. And the carers who are poorly funded, don't have enough time and no benefits have to be motivated by the solutions.

It is notable that the key issues raised within the open session were also raised by the three speakers and they were further debated within the ensuing session of questions and answers. Of particular concern was the issue of end-user participation. Ways of motivating and stimulating such participation were discussed.

Projects need to be based on actual user needs as perceived by the users themselves, they need to be presented in a manner which is interesting and the language used has to be easy and understandable.

It was noted that “funding rules” with regards to end-user organizations were not the same in the various EU member states, which made it even more difficult in some countries to get adequate user involvement. This aspect needs to be addressed as a matter of urgency.

Due to the fact that, in the future, there will not be enough people around to work as paid formal caregivers and not enough family members to act as informal caregivers, new ways will have to be found to look after the ever-increasing number of elderly people. Technology will have an important part to play, but other forms of service delivery will need to be found too. For example, more “volunteer” caregivers will need to come forward. The voluntary sector needs to be stimulated through better ways of funding and support for people who volunteer. This is particularly important if we wish to ensure that the “human-human” and not the “technology-human” interaction continues to remain in the spotlight.

SESSION D4 – PRIMARY PREVENTION

Birgid Eberhardt[1]

Outcomes:

The participants made valuable contributions to the orientation of the call topic "primary prevention" and brought into focus the difficulties associated with it. In addition, they provided information on barriers for the development and marketing of AAL solutions in the area of prevention, and cited existing case studies and ongoing developments. They further stressed certain general aspects that can help an AAL project to be successful.

Topics: Orientation of AAL Calls in the Area of Prevention and Associated Difficulties

One discussion group suggested focusing an AAL calls on **products and services that use data collected over the lifetime of a person** with the goal of efficiently preventing disabling diseases and thus maintaining the independence of individuals. The participants agreed that there is a need especially for analytical services that go beyond mere collection of data and data management in this field. The group agreed, however, that this call theme is applicable to individuals of all ages and should not be restricted to the elderly because prevention is a lifelong process. Prevention was thus seen as a topic that is rather difficult to address through the AAL Joint Programme as long as it focuses exclusively on the elderly. Furthermore, privacy standards are of paramount importance for such products and services, which could be difficult to achieve for SMEs.

Another group suggested focusing an AAL calls on **state-of-the-art information facilities for the elderly on disease and disease prevention**. The participants identified a clear end-user-driven demand for health information that is adapted to the elderly. ICTs can play an important role in this context and provide an opportunity for the elderly to access relevant information.

Another suggestion was to focus on **prevention facilities that foster healthy lifestyles**. As examples of such facilities, the group cited cognitive training games that allow mental and physical illnesses to be diagnosed and subsequently coach the elderly in the maintenance of abilities and in prevention of further loss of autonomy. The inherent strength of such facilities is their strong motivating effect on end-users.

[1] VDE, DE

The success of the Nintendo Wii as a training device in elderly homes provides evidence of the quick adoption of such prevention facilities by the age group concerned. A further example was provided by a health-care professional from Sweden, where pedometers have been distributed to the elderly and an online service allows study participants to compare their performance with that of their peers. The strong motivating effect of this study on the participating elderly further underlines the effectiveness of this approach. However, it has not been validated whether this approach works with frail elderly people or only with the healthy and fit ones.

Several groups mentioned **monitoring of the health status through non-invasive sensors** as a potential topic of interest for an AAL call. Different potential applications falling under this theme were discussed, including prevention of falls through sensors and alerts, prevention of chronic illnesses through regular monitoring, preservation of mental and physical abilities, etc.

Mr Moritz as a speaker of the session proposed a call topic with a strong social interaction component: he suggested an AAL call on **"Ambient Assisted Co-Living"**, which should support the development of solutions that allow the elderly to live in elderly or intergenerational communities. He stressed in particular that social interaction acts as a strong motivating factor for the adoption of new technologies by seniors. Furthermore, social interaction is seen in general as key to good health and well-being. The audience agreed that social interaction is indeed a very important factor in the adoption of new technological solutions by the targeted age group. This was further supported by another speaker who had performed a study on factors motivating the elderly to acquire new technological know-how: personal interaction and the strengthening of the personal relationship with grandchildren were the strongest motivating factors for the elderly according to this study.

Barriers: for the development and marketing of AAL solutions in the area of prevention

The participants agreed that technologies already exist and are well developed in the area of prevention, but that market introduction is seriously hampered by a lack of **integration of existing health-care management systems**. Management systems vary between municipalities as well as hospitals and undergo very rapid development; existing solutions thus have great difficulties in being adopted and are rapidly out of date or obsolete. A modular solution that is accessible to everybody is thus clearly favoured by all participants.

The participants agreed further that the discussed products and services centred around the topic of prevention can provide useful input to the elderly and carers; however, several of these services would need to **constantly involve doctors** who can ensure that appropriate advice is given to users. Such involvement of highly qualified health-care personnel complicates the development and market access of prevention solutions.

Even though participants agreed in principle on the usefulness of prevention solutions, some participants stressed that it is not clear what particular health conditions should be the focus of prevention. An individual faced with a choice of prevention products and services does not necessarily know what condition he should try to prevent, or in other words how to choose among the different prevention solutions. This **choice can best be made in hindsight**, i.e. once it is clear what difficulties an individual experiences. Therefore, some solutions may never be adopted early enough to prevent the occurrence of a health problem and thus may be obsolete.

Key success factors

All participants agreed that prevention solutions must be "fun" to be widely adopted and lead to translation into real action. Fun means different things to different people, but social interaction is usually a positive experience across a wide range of age categories. The social component was thus seen as a key success factor for AAL products and services in the area of prevention.

As prevention solutions may often be paid for by public or private health insurance, not only the business model but also the assessment of the cost-effectiveness of the product/service contributes importantly to the success of the proposed solution. Cost-effectiveness calculations should thus be a part of the AAL project if the product/service is paid for by health insurance.

Carlos García Gordillo "Prevention through empowerment"

The needs of older adults and the perception of such needs by other age groups were at the heart of this presentation. The speaker states that a lot of work has been performed to provide health-care professionals with tools, technological and pharmaceutical, to help with certain tasks in the care process. However, very little has been done in the field of re-engineering the care process itself. Re-engineering the care process should take a holistic approach, putting the care taker at the centre of the process and aiming at empowering the care takers.

Mario Drobics & Angelika Dohr "Active lifestyle management for improved well-being of elderly"

The speakers presented an analysis of the effects of what they described as a neglected lifestyle on health and well-being (CVD, malnutrition, diabetes, obesity, osteoporosis, depression, cancer). They then explored different lifestyle management strategies and their effectiveness in prevention of the described difficulties. In particular, the talk addressed the motivation of older adults to maintain an active and healthy lifestyle; one interesting result of their work is that intergenerational contact (i.e. with grandchildren) is a main motivating factor for the acquisition of new technological know-how.

Eckehard Fozzy Moritz "Socio-Technical Innovation for Health and Well-being"

The speaker developed in great detail a future call topic for the AAL Joint Programme on "Ambient Assisted Co-Living", the idea being that older adults start living together in shared housing, providing an opportunity for mutual assistance and preventing isolation and associated health problems. The proposal pays special attention to social isolation of older adults and its prevention. Social integration at the same time was seen as a strong motivator for older adults to learn and improve their lifestyle.

Conclusion

The topic "primary prevention" was clearly of interest to the roughly 50 participants present at the round-table discussions and during the presentations of session D4 and prompted a lively discussion. The contributions and the obtained feedback succeeded in outlining potential future call topics for the AAL Joint Programme. These topics, mentioned above, were:

- Products and services building on "lifetime data"
- Information facilities for prevention
- Prevention facilities fostering healthy lifestyles
- Monitoring/sensoring for prevention
- Ambient Assisted Co-Living

However, conceptual problems remain with "primary prevention" as a call topic. In particular, it is not clear how the topic of primary prevention fits into the current direction of the AAL Joint Programme: the stakeholders agree that a call on prevention should not focus exclusively on the elderly, but should address all age groups. This is especially important because the development of prevention solutions should be oriented toward the needs of the future elderly and not only tailored to the current generation of elderly people.

SESSION D5 – AAL AT WORK

Camelia Dogaru[1]

Outcome:

"AAL at work" has to be part of employment and workplace-related policies to meet the main objectives of companies, trade unions and governments, through:

- increasing productivity and competitiveness through sustaining and increasing the competences of the senior workforce
- maintaining the security and improving the health of the workforce
- learning and training for senior workforce to maintain competences
- improved compatibility of work and private life taking cross generations into account

Technology development and systems solutions have to be adapted to structures already existing in the workplace and work organization; they have to be really "assistive", which imposes a specific challenge on developers. A focus on one of the following specific application areas seems to be advisable:

- The new workplace
- The "knowledge organization"
- New concepts for learning and training for the senior workforce
- Sustaining health at work
- Family carers: compatibility of job and care – cross generations

The health and social care sector as a specific target for AAL

Perception

- Most of the companies do have problems, since not only do the employees become older, but they also have older parents to take care of.
- Technologies could be provided that could help people at an older age to adapt to the workplace or the other way around: some older people cannot continue to work the same way as time passes by.
- Giving the opportunity to people to work and live longer should not be seen as an obligation to work until a very advanced age, but rather giving them the opportunity to work as long as they *want*. One's status should not necessarily be decreased at 65 years old: this could lead to some form of depression.

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[1] CMU AALA, BE

- The knowledge transfer experience is also important and can be problematic. But older people should not be considered only as knowledge resources at work. For all people, not only older ones, being active at work can represent for them that they have a role in society; in this sense, work should not be considered purely as an economic activity.

Technology

- New technologies should enable the work activities to follow the person instead of the person to follow the work; they should provide adaptability possibilities to the work environment.
- The workplace should become part of the community, and not be so centred on computers; if possible, technology should become invisible, foster team relationships, and improve the possibilities of working whenever, wherever one wants, e.g. with more teleworking options.

One challenge is how to adapt the workplace to be used by older people and make them feel useful, without at the same time feeling stigmatized. Disabilities increase with age, and AAL technologies can help in adapting the work to specific disability environments.

- One important point would also be the need for more customization, which would imply that the technology is more expensive. It is then necessary to find a balance for the offered technology, the market price and the target scale of the market.
- Other aspects to be considered are the role of robots in the workplace, as well as telesystems and support systems, where the technology is already intervening.

Health and Training

- It is a fact that more and more hearing-impaired people will work as the age limit increases; they will need some help at the workplace.

On the other hand, one can consider the possibilities of enhancing health in the workplace, including opportunities to move, stress relief management and prevention at work, not only for older people.

- Being active is something viewed as positive by the person and the community; if one has health problems, having technologies to help remain active is interesting, if they provide services to help one stay active.
- Another important point is to provide technologies to help with retraining, in order to get back into work or change professions.
- It is not only a problem of the older workforce; it’s also about caring for the parents etc. from the workplace; one must not necessarily choose, but should be able to do both, with some work-care balance. This is part of the informal care perspective and the technology should also be able to support the informal carers, in order to improve the life of the elderly but at the same time of the carers.

Is the technology there? What do we need?

- It is much more about the services than about the technology that can be put in place very fast.
- One could benefit from social computing, since people have actual values: they are creative, innovative; one should build on that and help them to use their brains, taking models from crowd sourcing. It is not really about technology, but it is a service of innovation.
- AAL@work could also use robots for lifting objects, memory reinforcement, stress relief, etc.
- There is already available technology, but how to adapt it to the individuals is a challenge; people should be encouraged to use computers if these can provide what they need, not just use computers for the sake of it.
- AAL@work is linked to the motivation of the workforce, it requires acceptance and some research at and for the workplace.
- Technology should not stigmatize: at workplaces it is still a stigma to wear a hearing aid.
- Solutions for telework already exist, for example, and importantly, it is a universal market, not only for the elderly and/or disabled.
- Trade unions can be considered as end-users, since they might be interested in having the members employed for longer, if they are willing to; the trade unions must be involved in this type of discussion.
- There are a lot of technologies that could fit in an AAL project; the combination of solutions, the pilot, including social sciences, etc., can be useful, but not everything is ready.

What should be done?

- It is important to find out what the user wants and needs, since the industry wants to invest only in something that is needed by the users. SMEs will be involved if they are helped to find out what the user wants.
- If our society is ageing, it would be difficult to replace the older with the young, so it is necessary to find prevention solutions to maintain health at work and to help people to reach old age in better shape.
- Solutions are needed not only from the companies' point of view but also as a society solution (legislation adapted to help old workers to stay longer in business).
- There are a lot of ICT-related opportunities for AAL@work; it might be a difficult political and societal point, but this is not a reason to stop thinking and working on it, as this is already a demographic problem.

Javier Larraneta

Development platforms are mainly to establish research agendas and propose them to the one able to implement them. Some parts of the roadmap they established with eVIA two years ago now could be included in the future call.

Ageing is a new risk in companies. The relationship between ageing and work has to be considered with the active participation of the workers. Javier defined a shortlist of priorities as a base for their strategy and for the recommendations that they plan to send to the EC.

Considering human factors in the organizations and all the occupational safety related to risk and emergency situations is important. The average age is increasing fast in Europe, not only in companies but also among subcontractors.

As they use technologies in the companies in the last years of their working life, they can see these technologies as a potential help after retirement. A protocol of characteristics of demands from older workers in the companies, i.e. definitions and characteristics of work profiles, should be established. Smart working environments are needed, or in other words aged workers feel better in assisted working environments.

A question was whether they have taken into account the user point of view. Yes, a focus group was created, having a lot of delegates from companies and research organizations; they changed their perspective to develop a more human-centred roadmap.

Paul Thomas

The aim is supporting workers' careers even if they have to care for a family member. There is a need for informal care. It is not necessarily that the worker is becoming older but that everybody around him is getting older. E.g. in the UK there are about 3 million people caring without being paid, 90% of them are over 30 years old. They are twice as often ill as the non-caring workers. Technology is needed for innovative health and care solutions to help people in the informal care system. Bringing the elderly into a social network helps. A common platform that allows industry to build solutions for all kinds of people will be good, e.g. solutions available in the cloud, that are easily scalable. As an examples a Personal Health Record was mentioned. There will be a new programme in the UK, called DALLAS, starting from 2012.

Jan de Bruyne

The topic was the ageing in the Belgian railroad industry. In the next ten years 50% of the workforce will be retired. Managing not only the inflow in the company but also the outflow of workers is needed. They have to develop actions that could motivate people to stay longer in the work field: the average age of retirement is 55 in the enterprise; 26% of people are under the procedure of being declared as not able to still perform their jobs. That's typical for Belgium, where only 34% of the people over 55 are working – compared to Norway with 75%.

Knowledge management, employment and productivity are tight together. In a study they were asked about job satisfaction: for 35–45-year-olds the main concern (source of unhappiness) was communication and information; the group aged 45 to 55 was less satisfied but delivered the highest response. E.g. knowledge transfer can be managed by re-employment of retired personnel to help with technical training. The issue is how to ensure that their techniques (sometimes they are computer-illiterate) can be transferred to the new generation which is completely computer literate. The training of the old workers helps them stay active. So one has to motivate them to stay longer on board or at least keep them motivated at the end of their career. This can be done by changing the job profile eventually or helping with technological tools. One example is the AR-glasses with help functions for hands-free work. Another possibility is intelligent clothing – to measure the fitness of the personnel or fitness equipment with individual pieces, which allows them to measure themselves. Wearable sensors are unfortunately not a reality yet; it is not in use at the moment but is planned; it is definitely needed, but not that easy to implement – from a human and technical point of view.

Tharien van Eck

The age of "ageing" depends on the industry. There are a lot of myths about older workers. In fact, they are more productive, they are more engagement with their work and they want to be there. But there are no real comparisons other than those for specific professions as police or firefighters. One should say "mature" worker instead of "older" worker. At Johnson & Johnson they developed a white paper on ageing; the hope is to have it finalized by the middle of 2012. The aim is to enable older workers to work in good health. It had to use the existing programmes and to fit ageing into that. It is better this way and not to make it a special issue, since it is part of evolution.

There are a lot of tasks to perform:

- Create awareness about health from an early age, occupational health is legal requirement (age discrimination act);
- Support the mature worker in the workplace (handrails, bigger fonts, lighting; multigenerational groups);
- IT assistance (help the employees to become computer literate, help them to move to a different level);
- Work with the employees that are close to the retirement age to get them ready for retirement;
- Look at other methods of using your workforce with training and developments;
- HR management corporate culture has to be changed.

It is known that ageing is universal, not uniform.

Mohammad Reza

There are similarities between AAL@home and AAL@work. We already have ICT network artefacts that help to provide AAL services. E.g. we can introduce a so-called near body AAL space that moves and enters other AAL spaces. Then we have to look at the interoperability between AAL spaces. This concept of AAL space gives an abstract view that can help us to make some measurements. We should not only help the person but the business process itself is to be improved. Let’s prevent a fragmentation, there are so many different platforms, let’s look at what exists there; let’s stop developing many other platforms when there are already suitable ones.

TRACK D PAPERS

LEARN & NETWORK – DUAL APPROACH TO EMPOWER ELDERLY PEOPLE TO EFFECTIVELY APPLY DIGITAL MEDIA IN DAY-TO-DAY LIFE

Markus Stoisser[1]

The project Learn & Network aims to empower elderly people to effectively apply Digital Media in day-to-day life. It will conceptualize and develop a Web 2.0 platform tailored to the needs and wants of elderly people. An online platform becomes an integral element within learning scenarios instructing elderly people on how to successfully use social networking to connect with like-minded people and form sustainable relationships supporting social inclusion.

New Media, Digital Media and Social Media are well-known umbrella terms for the manifold challenges constituted by modern information and communication technology and foremost by the World Wide Web (Web). Social networks including Facebook, Xing or Twitter are effective instruments for connecting with like-minded people and planning joint activities online. Becoming a part of such virtual social networks is fun. Researchers speak of this phenomenon as "joy of use". Unfortunately, the huge added value of social networks currently remains hidden for elderly people. Social networking on the Web is both too complex and too dynamic and elderly people lack the necessary competences to develop effective social networking practices.

Empowering elderly people to effectively use social media requires teaching them such skills as those which digital natives naturally come along with: fearlessness, openness to new tools and technologies, eagerness to experiment and an affinity with social media. Digital natives develop their competency in media when using Web 2.0 platforms exploratively. But today's knowledge society requires that all people, not only the young ones, are equipped with at least a basic level of media competency. Younger people build up such skills automatically in school or business, more or less. However, this does not apply to elderly people as they need much more supervision. Unfortunately, competency in media cannot be taught in basic ICT courses, but requires a dual approach: learning how to engage with media has to be accompanied by intensively using new media. Computer literacy is the basic principle for developing media competency, but it has to be target group aligned and requires quantitative quality criteria to measure success. Three aspects – teaching, learning and using – have to be well balanced and equally considered when aiming to teach elderly

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people on new media – this approach is called Blended Learning 2.0 (figure 1). Only then can elderly people be empowered to build up a sense of community while socially interacting in the Web 2.0.

The project Learn & Network develops quality criteria for specially tailored learning courses which aim to teach elderly people how to effectively use social media. It will also investigate how to effectively adapt current learning material to the needs of elderly people. The main teaching and learning material is the Web 2.0 platform itself, which will be developed within this project and taught by instructors in courses. With this dual approach elderly people will be empowered to use social media effectively, while being stimulated in face-to-face learning activities to develop media competency.

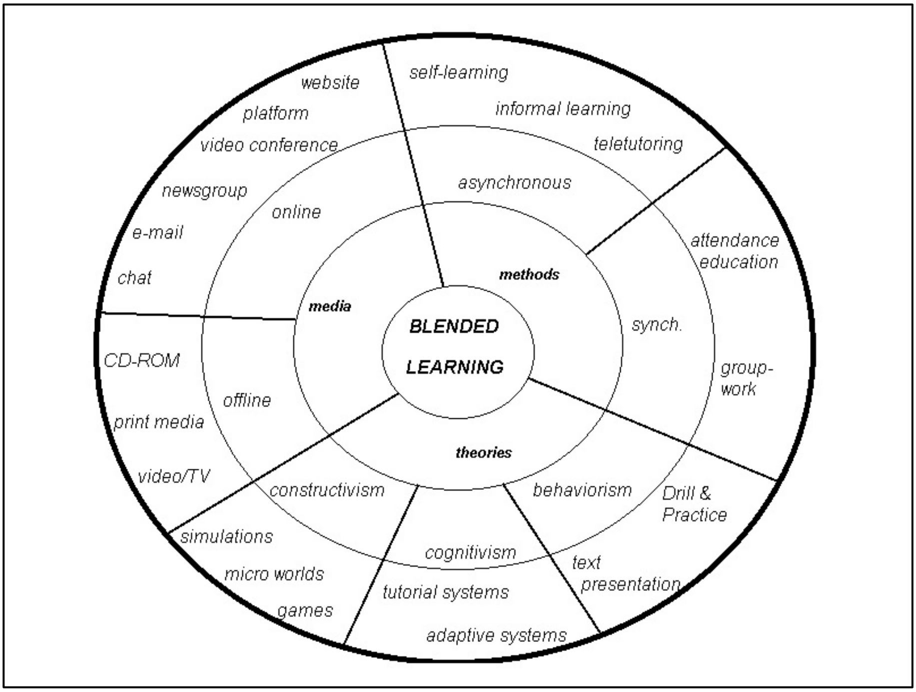

Figure 1. Degree of performance relevant to Wiepcke (2006, p. 69), "Blended Learning"

It is a fact that existing Web 2.0 platforms, including Facebook, Xing and Twitter, are far too complex to act as appropriate learning artefacts in courses. So the conception and prototypical implementation of an appropriate learn & network platform is one of the main purposes of this project. Elderly people will learn how to use this platform in courses, but the usage of the platform is not limited to the course. The added value of the project and its primary goal is to empower elderly people to sustainably use the learn & network platform to connect with like-minded people beyond the courses. By doing so, they will experience the joy of using social media. Adopting this platform is not encapsulated from learning how to use it, but learning is the key concept to convince elderly people of the added value from using new media. They learn step by step how to manage and extend their social network, interact with like-minded people and plan joint activities online. The project aims to contribute to the goal of social inclusion by using a dual approach – learn & network.

In accordance with the project progression, the working package of demand analysis and the concept of learning standards and learning scenarios has already been completed. In the body of the literature the outcomes of the survey expressly underlined the necessity for age-sensitive learning materials, the user interface of the platform and easy-to-use learning technologies. The main conclusion of the survey showed that education for elderly people has to be subject to some rules. Within the learning strategy there are considerable deficits based on the age-related impairment of the so-called "liquid intelligence": slowed information recording and a decrease in mental agility. These developments follow, by contrast, the so-called "crystalline intelligence": the rates of educability, concentration, retention and the ability to cope with exposure of information that continues up until old age. Empirical knowledge stays in good working order. Dealing with ICT draws in particular on the functions of the liquid intelligence.

Furthermore, it is said that under the learning process lie some influential factors: uncertainty, insufficient practice in self-determined learning, a lack of confidence (regarding learning tasks as well as techniques), and the poor health and fatigue of the elderly. New learning content has to be "connectionable" – they have to connect with available knowledge. The intensive use of the platform guarantees the success of the project.

The self-regulated learning aspect takes on an important role within the education of elderly people. Self-determination, learning management and meta learning, increase of competence (creative thinking, thinking outside the box), experience-based learning ("Joy of Use"), involvement of different senses (picture, text, video, music etc.), interactivity within the learning process (how to deal with mistakes) and the social aspect contribute to the important role in mediation knowledge with information and communication technologies – ICT and self-regulated learning react on each other!

With education for elderly people motivation is especially relevant. The ARCS model shows the best way to motivate the elderly:
A = **Attention** (catch the attention of the user/learner)
R = **Relevance** (second step: recall the importance and relevance of the learning content)
C = **Confidence** (always a positive success expectation)
S = **Satisfaction** (user/learner experiences satisfaction)

SENIOR CITIZENS USING 3D VIRTUAL ENVIRONMENT FOR FUN AND LEARNING

Hein de Graaf

Abstract/Summary

A presentation of the possibilities and challenges of the elderly using 3D virtual environment for themselves, mainly for fun and social interaction, thereby strengthening their social network. Information and learning (but also work) will be interesting for those communities as a subject to pursue, as long as pleasure and entertainment remain goal number one. I am not talking about Second Life here, as that environment is not very fitting for this target group. I am talking about a "Metaverse" built together with the target group and based on their expectations. I will discuss the choice of the baby boomers as the first target group for more reasons than that I am one of them.

What I would like to present to the public is that in future AAL Calls, strengthening social networks to battle exclusion and loneliness should always be on the agenda. All other goals are dependent on that, including information, learning and work. I have, three years in a row, proposed a project called VayaV in response to the AAL Calls, on this issue.

1. Methods

Four years of research in Second Life and Open Grid "worlds" on the opportunities and challenges that 3D virtual environments offer senior citizens. Discussions with key experts in this area and "the market" in the Netherlands.

2. Results

Social networks are all about meeting friends, making new friends, friends who are also providers of services and advice, friends who are experts on issues relevant to you. Sometimes the ties are weak, sometimes strong; they change with time and circumstances. But we really need them, especially when you get older and lose friends and the ability to make new ones. Nowadays they are called "social networks" but what they are is nothing new: friends, family, acquaintances that you can depend on and who can depend on you.

Since 2003 the world has seen the astonishingly quick rise of virtual social networks. Millions of users joined them, but only a small percentage of those are senior citizens. Roughly speaking, the analyses tell us that the relatively successful areas where senior citizens are active are the ones that are closest to their "lifestyle", their everyday experiences: email (reminding us of writing letters), search engines (looking up facts), and in principle, the virtual 3D environment (closest to meeting and making friends in the real world).

Email and search engines are already flooding the market. The 3D environment to meet people almost as in the physical world has been ignored until now. This is a feature Facebook cannot deliver: the possibility to meet in groups and interact in groups. The only examples are Second Life and business applications. Second Life is built by "residents", the users, as they see fit. A four-year research, carried out by me, showed that this is not the kind of 3D environment the elderly want. I will give examples of that.

What we need is a 3D "world" and interface (viewer) designed and built according to the specifications our target groups will provide. The main general target group at first should be the **baby boomers.** Baby boomers have two assets that make them very interesting as our target group: they have money to spend (most of them, not all) and they have, increasingly, time to spend! The Silver economy is all about the choices baby boomers are making, or will be making, on what to spend their money on and how to spend their time, especially in times of crisis and recession. The answer is roughly: 1. Pleasure: includes entertainment, hobbies and passions, cultural experiences, interaction with friends. Keyword is "fun"; 2. Personal gain: everything that you see as a way to better yourself: learning, security (also of income), prospects. Keyword is "investment"; 3. Necessity: refers to everything you need to be healthy.

In Europe we are insured for most things concerning "Necessity", including the acquisition of assistive technology and devices. The baby boomers are not expecting to spend their money on these products as they expect to get them "for free" (covered by the insurance).

So we should be aiming at Pleasure and Personal gain as promising **marketing goals**.
The marketing challenge is not the availability of (assistive) technology and devices but the question: do the intended users (among them our target group) realize their (future) needs? Will they be able to share those with the industry? Will they be able to make optimal use of the (new) products? And do they know what is available, and if not, will they be able to influence the development of new products they need?
Furthermore, they want to have knowledge about user evaluations of the products; the strength and weaknesses of a product, the threats and opportunities, the conditions to be able to use the product in their own specific circumstances. Safety issues in using new products are important for them. Services connected with new products are important too.

Lastly they want to share with their (virtual) community of friends the whole process of discovering their needs for (assistive) technology and devices (now and in the future), finding out what products are applicable, testing them in their own environment, buying and using the product and finding out what training is needed and what accessories are interesting to purchase.

Never before has there been an effort to combine “physical” means of social networking with the 3D world of virtual social networking in one package, together with other virtual means of communication (Web-based and video) tailored to be fun for the baby boomers and at the same time addressing their needs. The economic opportunities are there: in the years to come the number of baby boomers who can afford to pay for these kinds of ‘hands-on’ services will increase. The “baby boomers” are already in their sixties! They will become a very interesting market because of the available personal resources they have; this is called the **Silver Economy**.

The market experts have declared 55+ as the most promising market segment for the years to come. However, they are not yet targeted in an optimal way as the leading market experts are not very knowledgeable about how to approach 55+ and with what products. Baby boomers don’t like to be addressed as a caricature of “old and needy, but still going strong”; they are consumers who know what they want and are willing to pay for it. They are, most of them, “healthy, young in spirit and eager consumers” (description by PR bureaus like Ogilvy).

Secondly, baby boomers vary in their characteristics, but they share one thing: they not only want a concrete product, they also want the “experience” and the service that goes with it; it must feel good, and we must be sure that when needed we will have the right assistance available (read also: ‘Fifty Plus marketing’ by Edgar Keehen).

Thirdly, they want to spend more money on pleasure, fun and culture where meeting fine new friends is always the main trigger. Research institute Motivaction in the Netherlands, there is an increase yearly of 10% of expenses in those areas, due to the increasing group of seniors as clients.

Fourthly, they are less driven by emotional impulses when buying new products. They want to be informed by people they trust whether and how products are useful and do what they promise.

Fifthly, the Internet is no longer an unknown scary thing to avoid. They use it to find things out and to keep in contact with their friends and make new ones.

According to findings of the Dutch CBS and Motivaction, the 65+ group in the Netherlands had an expandable income of 29 billion euro in 1990, 36 billion in 2000 and 46 billion in 2009. One-third of the total private capital in the Netherlands is owned by the 65+ group (411 billion).

3. Discussion/conclusions

What I would like to discuss with the audience is that in future AAL Calls, strengthening social networks to battle exclusion and loneliness should always be on the agenda. All other goals depend on that, including information, learning and work.

SERVICE DELIVERY MODELS AND SOCIO-ECONOMIC ASSESSMENT OF OUTCOMES IN AAL INTERVENTION

Claudio Bitelli, Evert-Jan Hoogerwerf, Massimiliano Malavasi[1]

Abstract

Once a new AAL solution is available, the important questions that arise are how to make it reach the right users and what its real benefits are. It's very important for a more efficient pickup of AAL solutions to analyse the delivery models in place in the various countries/regions, but also, as a community, to contribute to their improvement and/or innovation in a rapidly changing economic, demographic, cultural and technological context. The Emilia Romagna Regional government, in Italy, has developed a widespread territorial network of services and centres dedicated to home adaptation, assistive technology and the assessment of AAL solutions' to increase the autonomy and safety of the elderly and people with disabilities. Statistics and data generated by this network are the starting point for a reflection on the opportunities and challenges inherent in service delivery initiatives and how they can further AAL. In particular, the focus will be on a critical analysis of the first results of an experimental project started in 2010 and dedicated to the evaluation of the intervention outcomes. A good understanding of the outcomes in terms of the socio-economic impact of AAL solutions is crucial for the development of the entire sector and for the redefinition and rescaling of models of intervention in the care sector.

Keywords social costs, SCAI, AAL outcomes, cost benefit in AAL

1. Introduction: AAL service delivery model

Once a new AAL solution is available, the important questions that arise are how to make it reach the right users and what its real benefits are. These are complex issues that embrace different questions. First of all, how can the information on the new solution reach final users, carers and professionals? Who decides that the solution fits a specific need? Who delivers and installs it? Who pays for it? Who trains the user on how to use it? And finally, who checks whether it works properly and evaluates the impact on the (quality of) life of the user, on its care environment and on society as a whole?

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Several models have been proposed to provide solutions to final users: from simple and direct “vendor-to-client” approaches to strictly regulated processes managed by social and/or health-care statutory bodies.

Social change and limits of an economic nature are constantly challenging all models and practices of service delivery in the field of AAL solutions. This is becoming increasingly clear now that many European governments are cutting back on welfare system expenditures, with the risk of reducing what were once considered basic rights and standard practices. In this scenario it is important to offer political and governance stakeholders clear and validated evidences of the positive impact of AAL solutions on social costs.

1.1 An example of a territorial network of centres for home adaptation assessment

The Regional Government of Emilia Romagna in Italy has developed a widespread territorial network of services and centres dedicated to home adaptation and AAL solutions, with the purpose of increasing the autonomy and safety of the elderly and people with disabilities.

To make sure citizens have access to information and are advised concerning the accessibility, liveability and safety of their home environment, a comprehensive programme called “Casa Amica” (Friendly Home) [1] has been developed and implemented. The network is composed of two highly specialized centres – the Regional Centre for Assistive Technology (Bologna) and the Regional Centre for the Accessibility of the Built Environment (Reggio Emilia) – and 10 local resource centres in each provincial capital. These “first line” local resource centres, officially called “CAADs” (Centres for the adaptation of the home environment) and governed and funded by the city authorities, operate with multi-professional teams (engineers, architects, rehabilitation therapists and social workers) and are directly involved in responding to the needs of single citizens and of their family members, carers or other public or private professionals such as architects, therapists, engineers, etc. They provide information and advice regarding the quality of life, the organization of the living environment, the functional use of the available space, the removal of barriers, the design and installation of AT and AAL solutions, and also on building laws, regulations and funding opportunities.

The two specialized centres have a role in training and supporting the local teams and they intervene only in cases where a complex assessment is required.

2. Methodology: an example of socio-economic assessment in home adaptation and AAL intervention

Research shows [2] the need to increase attention towards a more evidence-based assessment of the outcomes of any AAL intervention, in order to demonstrate how AAL and home adaptation solutions might generate important social benefits in terms of the empowerment, emancipation, participation and inclusion of elderly and disabled people. Another important aspect related to the provision of an effective intervention is that associated with the evaluation of the cost-effectiveness of any AAL intervention, and this issue is the focus of the present paper.

In order to respond to this important topic, the Bologna *Centre for the Adaptation of the Home Environment (CAAD)* has conducted a study evaluating its everyday operations in the light of current economic and cultural circumstances. Like other inquiries into the outcomes of our interventions, this study was conducted in order to arrive at a more precise and objective definition of our work, which consists in providing advice concerning the choice solutions, drawing on expertise of a multidisciplinary nature, independently of commercial interests, so as to contribute to the autonomy and quality of the lives of people with disabilities.

To choose the best tools of analysis (assessment of territorial needs, costs and outcomes of interventions, appreciation of services) we reviewed international studies carried out from the 90s, from which we have selected those most nearly corresponding, in terms of appropriateness and practicality, to the experiences to be investigated. In particular, the tool chosen for the socio-economic assessment was the *Siva Cost Analysis Instrument (SCAI)* [3], developed by the Don Gnocchi Foundation in the course of a study carried out for the Italian Ministry of Health. This instrument provides a means of carrying out a long-term economic analysis of the impact of AT and AAL solutions on care, calculating social costs in the context of projects designed for the promotion of autonomy [4]. In utilizing the SCAI, "social cost" is defined as the sum of the costs incurred by all the actors in a given situation, in the sense of how much is spent (cash disbursement) or in the sense of the economic value of resources committed with reference to:

- Technical solutions (purchasing, leasing, renting, etc.);
- Maintenance/use;
- Services related to the use;
- Human assistance (assessed according to the expertise of the caregiver): costs incurred by a public body (with reference to gross costs in standard operator contracts), or those represented by the assistance provided by family caregivers estimated with reference to salary (in this study reference is made to standard contact costs according to health and social care worker national labour contracts) [5];
- Cost of the processes involved (evaluation, training, etc.).

Although the SCAI can be used both before the proposal of a solution (as a means of supporting a choice between different alternatives) and after (for the analysis of outcomes or of AT and AAL strategies), this study was conducted to compare the social costs generated by technology-based solutions with those arising from non-intervention, with reference to actual interventions over the last two years.

These costs, of intervention and non-intervention, are estimated over a set period of time determined by what is considered suitable for the purpose (typically medium or long term), taking into account two temporal parameters:

- the clinical duration of the solution (number of years it makes sense for the user);
- the technical duration of the solution (number of years it lasts before "breaking").

Where the technical duration of a solution continues beyond the end of the chosen temporal horizon, the possible "residual value" has to be estimated.
As a last step, the social cost of the intervention is then compared with the costs of "non-intervention", i.e. the social cost which would have been incurred over the same time period if the intervention had not taken place.

3. Summary of results

The socio-economic assessment is being carried out in stages. The initial stage included 12 interventions.

The outcome of the analysis highlighted:

- A significant increase in the autonomy of persons with disabilities thanks to the identification of appropriate and adequate solutions that lessen the assistance that caregivers have to provide on an everyday basis or even make such assistance unnecessary;
- Improvements in the quality of life of people with disabilities, associated with the possibility of remaining in their own homes and profiting from improvements in access and control of living spaces;
- Notable savings, in terms of overall social costs, already in the medium term.

The savings were also remarkable on interventions, ranging from €4,000 (simple adaptations) to nearly €200,000 (restructuring and home automation system), as well as on social costs, ranging from a minimum of €9,000 in 5 years to more than €300,000 in 10 years.

The cases analysed clearly showed that interventions of this kind, if well designed and conducted, can be an important instrument not only for handling social problems (the relationship between a disabled/elderly user and his/her family) but also for reducing the costs borne by public bodies. So significant are the data that it suggests that a deeper and more wide-ranging study could contribute to changing investment policies by directing them more towards subsidized housing for vulnerable groups.

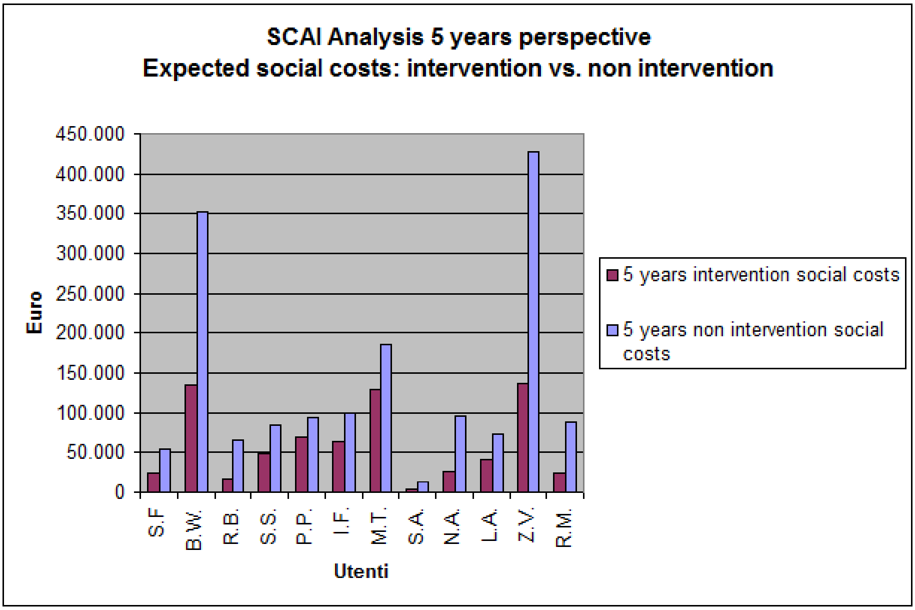

Figure 1. Adaptation of domestic environment. SCAI analysis of 12 service users

4. Conclusions and prospects

The quality of service delivery models is a key factor for a greater diffusion of AAL solutions. The work described here has brought us in contact with tools for the measurement of outcomes which make the evaluation of AT and AAL interventions more objective. This is an ongoing process in our centres; it is therefore appropriate to draw preliminary conclusions and identify further challenges:

1. A correct and systematic approach regarding the proposal of AAL and AT solutions can generate results whose efficacy and cost-effectiveness are demonstrable.
2. Analysis and comparison of the existent and proposed service delivery models for AT and AAL solutions is crucial to their greater distribution. The AAL community should contribute more to this process.
3. In the light of the changes in the social and economic context, the AAL service provision sector should adopt a logic based on producing evidence. Cost analysis and measurement of customer satisfaction have now become more central than ever in resource planning, in the designing of initiatives for the improvement of the quality and efficiency of assessment and prescription processes in social/health care and in the provision of public funds for interventions seeking to increase safety and autonomy.
4. Interpreting social costs as resources committed in different spheres (health, social services, school, work, family, primary network, etc.) opens up new

horizons for an awareness of the real social impact of the proposed solutions [6].

5. The entire AAL community is involved in providing reliable tools of analysis of the socio-economic impact of the solutions proposed. We need both retrospective (to assess the impact of a chosen solution) and prospective tools (to support choices when different solutions are available, including the choice for non-intervention).

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PREVENTION THROUGH EMPOWERMENT

Carlos García-Gordillo[1]

Abstract

Care processes have not evolved at the same pace as society; they continue to be caregiver-centred rather than client-centred. Consequently, caregivers act only in areas directly connected with their profession, disregarding all others affecting their client. Furthermore, almost all improvement to the care process has been based on adding person-hours or ICT tools to an unchanged process. To really change the care process, we have to start by considering the client as an able, intelligent person, capable of taking their own decisions. Re-engineering for active and healthy ageing or AAL implies focusing on the right target group: the 60–70-year-olds. A simple everyday interface between the person and the world should be used, with the mobile phone or the PC/laptop/tablet being the best candidates. The re-engineered process should aim at providing the person with all information empowering him or her to take the decisions that affect his or her life: social, health, financial, etc.

Article

"The problems that exist in the world today cannot be solved by the same level of thinking that created them." Albert Einstein.

So far, we have been witness to how society has approached the challenges posed by an ageing 21st-century society with care processes designed in the 19th-century. All we have done is to provide the expert with tools, technological and pharmaceutical, to help in certain tasks of the care process. Very little has been done in the field of re-engineering the care process itself.

I see three main reasons for this sorry state of affairs. First, our focus is on caring for acute problems, not on preventing their occurrence. It is like the person who, seeing a banana peel on the pavement, is ready to help anybody who trips but is not capable of picking the peel up from the ground. Even though different expertise is needed for each of the processes, anybody can see that it is cheaper to remove the banana peel than to heal the injured. As is often the case, the expertise for the solution of the problem, a street sweeper, is cheaper than the healing of the problem, a health-care professional.

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A second reason is that we treat the human being as a sum of parts: health, social, economic, cultural, etc., with each "expert" dealing exclusively with his or her part, disregarding the interrelation with the other aspects of the person. The approach to the care process should be holistic. A human being is not a sum of parts; it is a whole in which whatever happens in one part greatly influences what happens to the other parts and to the whole. None of the parts should be treated separately. If my elder brother dies, I may fall into a depression, but most likely the help of friends will be a lot more effective than Prozac.

And thirdly, and by no means lastly, we will not solve the issue of the well-being of an ageing society with processes based mainly on person-hours and equipment. We have to adopt the principles of modern management to re-engineering the care processes. We could learn from the – today not very popular – banking sector. Some ten years ago the process of sending a bank transfer followed a pattern designed in the 19th century. We would go to the bank and ask a teller to fill out a form by hand with the required information, then we would sign it, the teller would verify the signature in a card and, countersigning it, deposit the slip in an outgoing tray. From there, a very complicated mechanism of human intervention and notations would end with a coded wire sent to the recipient's bank. The reverse process would then be followed at the other end, finishing with a posted letter informing the recipient of the transfer. This process was first improved with the help of technological tools. Handwritten forms were replaced by machine formats. This is where the care sector is today. But then banks introduced a complete re-engineering of the transfer process. Today the customer, from home, sets in motion a completely automatic process to transfer money from account nº1 into account nº2, and in real time!

The banking system has re-engineered the transfer process by empowering their customers, allowing them to be in charge of managing their accounts. Today bank tellers have almost disappeared.

And underlying all the previous reasons for our failure is the fact that the care sector treats people as cattle, not as human beings. Most caregivers treat their customers as property; they talk of "my patient", "my client", etc. This tendency to relate to people as if they were their personal property is the basis of how they deal with them. Going back to the banking system, could you imagine if we had to go through a burdensome process to get a statement from our banks? Well, this is what happens in most instances if we dare to ask for our health record. What's more, they will produce an edited copy of it, never a full version with all the notations. There are two reasons for this. First, despite all public pronouncements to the contrary, professionals still think that my health record belongs to them. Secondly, they think that I am too stupid to understand anything, so what is the use of giving me information that I am incapable of comprehending?

If, on the other hand, care professionals started thinking about people as people, capable of understanding things if provided with the right information, things would change.

Let's look at two "recent" examples of how care professionals should behave. There is a shoe repair shop in Madrid, established in 1948. There is a big sign in the workshop that reads: "What is a client? The client is the most important person in this shop, no matter how he gets in contact with us, whether in person, in writing or by phone. The client does not depend on us, we depend on him."

I have an even "more recent" example. It relates to a certain Rufus of Ephesus, living in Ephesus (today Turkey) in the late 1st century. His teachings emphasized the importance of anatomy, and sought pragmatic approaches to diagnosis and treatment. He wrote: "The patient must be interviewed. By means of these questions, it is possible to learn a great deal concerning the illness, which enables a better treatment. The time that an illness began is also important. In addition, one should inquire as to the patient's attitude toward life and general mental state. In this way, the patient's mental health can be assessed." I would like to emphasize the part that reads "one should enquire as to the patient's attitude towards life" … No comment.

My point is that we need to re-engineer the care process and move beyond today's focus, which only means wasting more person-hours and more gadgets on an obsolete process. We really need to think about the people we are serving. We need to empower them by realizing that they are able, intelligent people, capable of taking their own decisions if only they have the right information.

If we could keep in mind those three + one paradigms we may be able to move away from the pilot trap towards efficient processes. Then we would have achieved: preventive actions, with a holistic vision; and care processes designed for today's economic and demographic environment, and which empower people to have complete control of their lives.

Focusing now on active and healthy ageing or AAL, there are a couple of more things that we have to take into consideration before plunging into re-engineering the care processes.

First, let's consider lifestyle. Overweight and obesity, social exclusion, lack of physical exercise, bad eating habits, etc. are all causes for future medical conditions that will jeopardize our well-being as years accumulate. I want to emphasize *future* because things rarely happen overnight. It is through years of stuffing ourselves with spaghetti alla carbonara that we easily become overweight and most likely will develop some cardiovascular disease.

So, what is the chance of having any success with a target population that has not been aware for years of the need for controlling its habits? Of convincing them that the time has come to change? Do we really believe that a person in his or her seventies will suddenly introduce radical lifestyle changes, learning how to eat more healthily or how to use a new gadget? Can't we recognize the fact that what we are subtly transmitting to that 70-year-old is: now, now, you are really old and frail; the time has come to surround you with machinery that will make sure you are not going to do anything stupid.

Let's look at who exactly is our real target population. Consider that from the time somebody has an idea to the time that the product gets to the market, seven to ten years can pass – one or two years for inception, three to five years for research, and three years, more or less, for production.

With this time frame, we should be designing for people like myself. I am almost 60 years old and I will probably need something in ten years' time. Whatever we design should build on the lifestyle of today's average 60-year-old, so that I don't suddenly feel that I am old. What's more, my needs will evolve over time. I really don't want to keep adding changes to my lifestyle or gadgets to my house that require a new learning process; I would like to have a simple ubiquitous interface with whatever I need.
There are two clear candidates for taking up the role of interface.

My first candidate is the mobile phone. The figures from Eurostat reflect the use of the mobile phone among persons in the 55-74 age range. In most countries, more than 60% of the population in the 55-64 age range uses the mobile phone.

The other gadget that a large proportion of the population is familiar with is the PC, laptop or tablet, whichever you prefer. Taking advantage of one of their many features, the Internet, let's see how popular it is according again to Eurostat. Obviously the Internet is not as popular as the mobile phone, but among the big EU countries, only Poland is under the 10% threshold in everyday use of the Internet for a similar age range.

Summing up, we should aim at re-engineering the care process by developing an information management system, which would serve as the sole interface between the citizen and the rest of the world. It should allow access to all health, social, family, financial and any other information the citizen needs for his or her decision-making. It should also be the interface for command and control of equipment that is meant to assist in activities of daily life and independent living. It should be modular so that every person can choose which modules better adapt to his or her particular needs, facilitating a smooth transition from middle age to old age and older. It should empower people by refocusing the care process on the person and not on the professional.

Let me finish the way I started: with a quote. This time it is from the well-known American radical feminist activist, writer and poet Ms Robin Morgan:

"Knowledge is power. Information is power. The secreting or hoarding of knowledge or information may be an act of tyranny camouflaged as humility." Robin Morgan.

ACTIVE LIFESTYLE MANAGEMENT FOR IMPROVED WELL-BEING OF ELDERLY PEOPLE

Mario Drobics[1], Angelika Dohr[1]

Abstract

The well-being of individuals is influenced by various mental, physical and social aspects. While some aspects are related to personal predisposition or the environment and are thus impossible or hard to change, personal lifestyle, which can be influenced much more easily, has a significant impact on several of these aspects. Frequent physical activity, for example, reduces the risk of heart-related diseases and also of severe fractures due to falls. Consequently it is important to maintain a healthy lifestyle throughout the whole lifespan, and living healthily is especially important for elderly people.

As a main focus of the AAL JP is to reduce the dependency of the elderly on external help and to improve self-empowerment, we propose forcing the development of tools which support users to improve their lifestyle by providing individual support. This support might be individual feedback on their behaviour and on detected changes, individual tips for improvement, as well as general recommendations and services. Professionals should be integrated in these scenarios to participate in the guidance and to intervene in case of actual need.

When developing solutions for and with elderly people it is important to consider their different experiences, abilities and needs. Therefore, and as personal lifestyle may change over time, solutions supporting people in managing their lifestyle have to be flexible and cover different aspects of their lives. Furthermore, solutions have to grow with the users. In doing so, the user can get familiar with the usage of new technologies more easily and learn step by step how to use additional functionalities. Growing also means that with increasing needs, additional external support might be integrated (nutritionist, physician, etc.).

Such applications are helpful for Go-Goes as well as Slow-Goes, and help to improve their quality of life, as well as their overall health status, and thus support them in staying independent for a longer time.

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1. Introduction

Independent living has become an attainable dream for elderly people through assistive technologies. In addition to the developments in the field of smart living, lifestyle management becomes increasingly important. The awareness that a healthy lifestyle increases well-being, especially in the case of a chronic disease, supports the need and potential for developments in this area. The individual motivations to use applications in the area of lifestyle management are heterogeneous, ranging from increasing or maintaining physical fitness, to achieving a desired weight reduction or preventing or treating chronic diseases

The target group for such applications is all health-conscious people, but especially elderly people who aim to maintain their well-being and independence. Due to the increased life expectancy and the relatively early entry into retirement (men at age 65, women at 60 years in Austria), the last phase of life (retirement) has to be differentiated further: older people in retirement, who are physically and mentally fit, are so-called "Go-Goes"; after this phase, elderly people who already suffer from chronic illnesses and are dependent on outside help are so-called "Slow-Goes". In nursing science, older people who are in full care are called "No-Goes" [1].

Lifestyle management applications appeal to people who are still active (Go-Goes), as well as to people who try to remain active (Slow-Goes), thus creating an easy and non-stigmatizing entry level for Ambient Assisted Living (AAL) applications. The voluntary confrontation with one's own life and the active involvement of the users during the development can contribute to an increased familiarity and acceptance of AAL applications with increasing age.

2. Personal lifestyle and the process of aging

The process of aging (WHO, 2001) is affected by different factors such as the living environment, lifestyle, and the presence or absence of chronic diseases. These factors vary with age, but do not define age. Social and economic factors such as prior employment, education and residential area, as well as behaviours like smoking, physical exercise, activity in daily life, alcohol consumption, nutrition and social contacts, are important influences in the process of aging and are therefore described in the document "Keep fit for life" by the WHO, which includes recommendations for elderly people [2] [4] [5].

One of the maxims in the care of elderly people is to overcome avoidable dependency situations. Such situations are often caused by a lack of motivation or challenges in everyday life. The consequence is accelerated degradation of mental and physical performance. By following the principles of self-empowerment, such situations can be detected at an early stage and probably avoided. Additionally, elderly people can arrange their therapy together with physicians. Thus they are forced to consciously deal with their own health status, in order to influence it through a more active lifestyle. This is intended to promote personal responsibility, thereby maintaining or improving individual independence.

In daily living, this self-responsibility can be actively promoted in different situations. In the following, these three central aspects of health are considered in detail:

- nutrition
- drinking habits
- physical activity.

Health plays an important role for elderly people as many of them are affected by a chronic illness such as dementia or diabetes. An active and more conscious approach, supported by appropriate systems, can contribute to a more effective treatment of the disease. In addition, appropriate monitoring and alarm systems can contribute to personal security while strengthening individual responsibility.

Diet and drinking habits influence the well-being of everyone, not only at an old age. Often the nutrition of the elderly is one-sided or inadequate and thus can cause more serious conditions such as osteoporosis or hypertension [3] [5]. Through the application of assistance systems a basis for active engagement of one's diet can be created and specific instructions on possible improvements can be given. As elderly people do not often feel thirsty, supporting their self-awareness in this respect is highly important.

An **active lifestyle** is particularly important at an advanced age. It strengthens the body and can thereby prevent accidents and injuries, and create a better awareness of the body. For many older people, housework and work in the garden are integral parts of their physical activity, but they are more and more reduced with increasing age. A continuous collection of activities can detect deterioration at an early stage and encourages people to keep active by providing individual motivations (e.g. by fostering social interaction).

3. Technology application for elderly people

People of advanced age are a special target group in terms of technology development. The existing experience of life and the experience with special objects of daily life (e.g. remote controls for TV) and the tasks assigned to those objects (for example, selecting the programme, adjusting the volume) seem to be fixed for elderly people.

If an object such as a mobile phone (which is primarily there to make phone calls) fulfils other tasks, elderly people often react with suspicion or uncertainty when the goal for those tasks and the additional tasks themselves have not been clearly defined and declared [2].

On the other hand, elderly people who already have experience with computers, mobile phones and other technologies, and the use of multiple devices for different purposes, have now become the norm. Nevertheless, the problems relating to the application of information and communication technology (ICT) remain the same and can be summarized in the following categories [4]:

- **Cognitive complexity**: Information processing and utilising the technical applications are difficult to understand for elderly people. A simple design of the user interface and the individual modules is necessary.
- **Motivation**: Inner attitudes, fears, restraint and acceptance are all aspects of motivation. Contrary to the general opinion that people of advanced age do not like new technologies, we observed in the project PDR-Eval that elderly people accept innovative technological applications and also like to use them if the goal is clearly defined [2].
- **Physical challenges:** Because of limitations due to physical changes through the biological process of aging, such as decreased mobility of the fingers, impaired vision, impaired hearing and longer reaction periods, the usability of technical aids for the elderly must be taken into account in the planning phase.

However, when designing technical applications for people of advanced age it is important to consider the balance between support and independence, and between safety and privacy. Technical applications are designed primarily to compensate for physical deterioration or cognitive decline and to support the older person in his/her environment at any time [5].

Figure 1: An example of a lifestyle management application for elderly people detecting eating and drinking habits as well as activity and providing direct feedback by changing colours of symbols (drinking glasses) and on the collected data via “personal advice”. The application is ANDROID based and runs on a tablet PC**.**

4. Potentials

4.1 Interactivity possibilities

Active lifestyle management requires and supports a high degree of interactivity, both with the system and with other users and professionals. Social and game-oriented approaches might provide additional motivation to actively participate in such applications. Surveys show that the need to exchange information remains important until a high age. Diminished mobility due to physical impairments restricts elderly people from exchanging information. Watching TV together virtually, while staying in one's own flat or house, allows for information exchange, although the mobility is limited. Bill-board functions displayed on TV give an overview of what is going on outside and help not to lose the social point of contact.

4.2 Product (concepts) or showcases

Showcases demonstrate the current developments in research laboratories and offices around the globe. Lifestyle management comes to our attention in many applications. For example: Personal fitness coach, Activity monitoring and training for fall prevention, Nutrition monitoring and support, Fitness community for joint training, Virtual nutrition coach, Calorie counters, Step counters, etc.

4.3 Business case focus

For this kind of application there are basically two business cases. On the one hand, active elderly people might buy such a system to ensure they are doing well and to record their activities for **personal use**. Being in retirement means having much time for oneself and one's own body. The active dealing with active life requires potent tools to gain, store and process information.

On the other hand, professionals, care-givers and communities can provide **special services** based on the information collected by such applications, like special nutrition support, activity programmes, etc. As making demands on services for the elderly is getting more and more popular, personalized services might demonstrate added value.

4.4 End-user involvement

End-user involvement is a major issue in this kind of application as insufficient experience of the actual demands on such a system (user interfaces, sensors, types of service) is available. Users have to be involved in the whole technology development process, beginning with the planning phase, until the product or application enters the market. This involvement increases acceptance on the one hand and helps to enhance usability on the other side. Developing applications together with elderly people often brings in new/other points of view and offers the opportunity to answer to the demand of the market.

4.5 New project results or findings in research

Relevant research findings will range from improved know-how on the need, design and actual effects of active lifestyle management to technological findings on individualized services, lifestyle-related data gathering and user interface design.

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TRACK E RATIONALE

European Policy for Ageing Well in a Global Context[1]

Ageing is one of the main three challenges for the Europe 2020 policy. The role of ageing and ICT in the current European political arena is of such high prominence that it has been selected to be the first pilot development under the Innovation Partnership initiative.

Due to such high relevance, there are numerous initiatives being deployed in Europe and in the rest of the world.

This track aims to clarify the political context we can expect in the short to medium term through the analysis of some specific issues.

- What is the rest of the world doing about it? We will see what some few countries are doing.
- What is the full picture of policies and programs in Europe?
- What is the roll of the regions in the deployment of AAL tech?
- What is different in the south European regions? Are there only threats or are there opportunities?
- We are listening frequently that social innovation is a new way to face societal challenges, but what is that about? How will it be useful for AAL deployment?

Session E1 - A global vision on ageing. Policies, programs and expectations around the world

Ageing policy, research, and markets in USA, Japan and Canada.

The population ageing is not only a European challenge. Other regions around the world are equally affected by the problem, but may be tackling the challenge in different time frames and solution-finding approaches.

Undoubtedly, the varying degrees of severity and time urgency of the problem will trigger certain parts of the global markets before others. The cultural, economical, and societal situation of the population will also strongly influence the orientation of the proposed and deployed solutions. Achieving critical mass is clearly a powerful competitive advantage to enable technology adoption.

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[1] AAL Forum 2011, OnSite Guide and Programme

Therefore, the following questions may become the cornerstone issues to global market developments:

- What is the expected population evolution in the USA, Canada, Japan and other countries?
- What are the policies, research investments or social approaches that are being implemented in these countries?
- What are the market barriers in these countries?
- What is currently available in the market?
- Could we get valuable results from the field to speed up our own markets?
- These questions will have a strong influence on the development of the European market and, as such, it is important to foster a global perspective when answering them.

Session E2 – European ageing related policies

The objective of this session is to have a full picture, at political level, of all initiatives going on in Europe, related with ICT and Ageing. The session is specially focused in the future, assuming that participants in the session are already experts on the field.

Now Europe 2020 is going on, as part of it we can find the first efforts done around the Digital Agenda and the Innovation Union. At the same time the European Strategy on ICT for Ageing Well has been reviewed and Horizon 2020 is being defined.

We expect from the session a clarification of the full picture of ICT for Active and Healthy Ageing in Europe, the relationship with the AAL JP, the vision from the users about this full picture, and also the role of some concrete initiatives, like the one going on for interoperability in the AAloA Lecce Declaration.

Session E3 – Regional innovation policies for an ageing society

The session will highlight regional strategies for end user involvement, funding schemes and network building, and will explore the links with the AAL Joint Program and the European Innovation Partnership on Active and Healthy Ageing from the Regions point of view.

Although a growing number of pilots are deployed across Europe, which are able to give feedback about the real possibilities that AAL technology could provide, large-scale deployments remain scarce. Identification of the barriers for innovation and of the ways regions could address those barriers is essential for the replication of best practices over all of Europe.

The objective of the session will be to gather representatives from the most advanced regions in terms of AAL pilots and to hear from them: what did they learn and what are the identified barriers, what are strategies to overcome those barrier and how can interregional collaboration accelerate the innovation process. Of particular importance in this respect are: end user involvement, funding and networking.

Session E4 – Getting older in Southern Europe

Southern European countries are facing a more abrupt breakdown of the social and family models than those of Northern European countries. Globalization has aggressively affected rural territories in the Southern European countries, and is severely threatening the model of their economic sustainability.

Furthermore, Southern European countries are traditionally dependent on tourism, where population, culture and lifestyle play a significant contributing economic role.

New technologies and the ever-increasing ease of travel are factors that could contribute to redefining these rural territories. A population's ageing can either become the decisive ingredient for depopulation or it can form a new mode of lifestyle.

This session aims to provide an overview of the problems that could be faced by the Southern European countries and, more importantly, of the possible solutions and the resulting new opportunities. Social innovation may be able to play a key role in addressing the challenge.

Session E5 – Social Innovation in Active and Healthy Ageing

The challenge of the AAL technologies in Europe in this moment is to impact the market. To do that, technology should reach users needs, priorities and expectations. We should be able to make users feel technology as allied in their daily lives, and to develop business models suited to the complex market context of active and healthy ageing.

One solution to such big challenge is Social Innovation, a concept now becoming fashionable.

At this moment there are in Europe several initiatives promoting Social Innovation and all of them talk about "active and healthy ageing".

However the concept of what social innovation is, applied to AAL, not always so clear. How to use this approach under the AAL JP is unknown, and the synergies and boundaries of the different initiatives with respect to the AAL JP need a deeper analysis. The objective of this session is to start this debate.

TRACK E NOTES

SESSION E3: THE EXPERIENCE FROM AGEING RELATED INITIATIVES IN THE EUROPEAN REGIONS

Kareithi Gitau[1], Peter Reymaekers[2]

Amongst the key challenges Europe faces is a rapidly ageing population. This has drawn the attention of European Union policy makers and in the Europe 2020 policy under the Innovation Partnership Initiative ageing has been the first priority. It is against this background that the AAL Forum 2011 in Lecce was organized.

Session E3, The experience from ageing related initiatives in the European Regions, chaired by Peter Reymaekers of Flanders Care, Belgium, was tasked with exploring the experiences and challenges of different European regions in deploying AAL (Ambient Assisted Living) technology for active and healthy ageing. The chair gave a welcoming address and opened the session by stating that the objectives of the session were policy strategies formulated by various European regions and their barriers, how the end users (the aged) are involved and their experiences, and lastly how the regional strategies can be harmonized with a view to creating inter regional collaboration to accelerate the innovation process and build networks for replication in other parts of Europe.

In particular he mentioned that strategy development experience should focus on funding schemes, their regulation (that is, the legal instruments) and how to build manpower capacity. In closing these opening remarks, he asked the speakers to relate their experiences in establishing a clear mechanism for regulating the participation of public and private sector players given that the funding is almost exclusively public.

He then invited the speakers in the order listed:

- **Smart Care: How to solve the financial barriers?** by Mariëlle Swinkels
- **AAL strategies in the Basque Country** by Josu Xabier Llano Hernaiz
- **Social innovation for the quality of life in Friuli Venezia Giulia, Italy** by Giulio Antonini
- **Experiences from Halland, Sweden – An ageing related initiative** by Ann-Mari Bartholdsson
- **SOCIAL Apulia: SOCial Innovation for the quAlity of Life in Apulia** by Adriana Agrimi

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Smart Care: How to solve the financial barriers?

by Mariëlle Swinkels from Provincie Noord-Brabant in Eindhoven, The Netherlands.

Mariëlle Swinkels began by presenting to the audience the Smart Care project which is a regional project deployed in the province of Provincie Noord-Brabant in Eindhoven, the Netherlands. She mentioned that the Smart Care project is ICT-driven AAL technology in which the end user is central. The primary goal of the Smart Care programme is to use ICT as a tool in self care and in caring for others.

The highlights of the Smart Care Project were:

The project has been running for four years with aims being the realization of comfortable living and that the elderly people involved in it can take care of themselves.

The project involves the regional government and other partners. In total a consortium of 26 partners are involved, including municipalities, private companies, health organizations and welfare organizations.

A common ICT platform connects 50,000 homes. The ICT platform includes categories of young and old and caregivers as well as friends. Smart services are afforded at home. Specifically, end users can use ICT to relay health indicators such as their blood pressure and weight. A secondary innovation has spun-off from this, called a Health Kiosk, which is a common meeting place for the users with the benefit bringing social connectedness. A positive environment is created from the social contact of the users with the result being encouragement of each other, meeting friends and beating loneliness.

The main barriers encountered are:

- lack of match between supply and demand.
- in the worlds of care, housing and welfare, each have their own working methods, processes and dynamics.
- every application has its own technical preconditions, creating problems in connectivity or broad scale use.
- lack of cohesion in the system of expenditure and income.
- insufficient exchange of knowledge, experience and best practices.

The key legal innovation role has been the decentralization of systems, five key laws have been adopted that allow for decentralization up to municipality level with the key benefit being participation of insurance companies.

In conclusion, Mariëlle Swinkels further pointed out the need for the government to play the following key roles:

- Further stimulate the public and private sectors to participate in this project.
- Devise a new financial model to meet the needs of participants.
- Development of an interregional model.
- Regional and Interregional research on key challenges anticipated.

AAL strategies in the Basque Country

by Josu Xabier Llano Hernaiz from Basque Country in northern Spain

Josu Xabier Llano Hernaiz began his presentation by drawing to the attention of the audience that the Basque Country in northern Spain enjoys a high degree of autonomy compared with other European regions. The region has a population of about 2.2 million, has two languages and self-governance. Funding for healthcare is public but there is participation by both private and public sector. The Basque public health system has a budget of about 3.546 million € and there is one main public health service provider. Health expenditure in the Basque Country is expected to double by 2020. In response to this challenge, the Basque government has set out fourteen strategic projects of which two are directly related to AAL technology.

He then gave a run down on O-sarean, the Osakidetza-Basque Health Service channels project, a relationship model which is not a face-to-face service, focused on the needs of the patients, citizens and health professions. The main objective is the development of a multi-channel services centre that allows interaction of all the citizens of the Basque Country with the health system, enabling procedures, simplifying the life of citizens and giving prestige to the work of health professionals.

He outlined the achievements after one year:

- Development of a website.
- Self-Managed appointments.
- A call centre for health counselling for the whole population.
- Development of customer relationship management (CRM) function design.

Data on patient-managed appointments, was interactive voice response (IVR) 60%, call centre 26%, and internet 11.26%. The challenge is to shift more of this activity to the internet. Face-to-face versus non face-to-face appointments was 90% versus 9% by phone. The opinions of the user on interactive voice response (IVR) was that 71% were positive about it and 8% were negative, on the other hand the opinion about the internet was that 93% were positive about it.

The social care system is the responsibility of different authorities but new legislation was introduced in 2008. Access to this system is now regulated by the law which is well defined.

Other benefits derived are :

- A home device has been developed for monitoring.
- Development of human resources led to creating the positions of area coordinator with clearly defined duties, roles have also emerged for installation and maintenance technicians.
- Home care units developed also offer the benefit of primary human contact.
- The service is partly paid by the user and the rest by the government, this is regulated by the 2008 law.
- The cost of the service is low.

Social innovation for the quality of life in Friuli Venezia Giulia, Italy

by Giulio Antonini from Friuli Venezia Giulia in northern Italy.

Giulio Antonini started with some regional data, that Friuli Venezia Giulia is in the north-east of Italy with a population of 1,233 912 (in 2008) of which residents aged 65 years and above constitute 23% of the population. In excess of 10,000 of them are living in home care.

The primary goal was to overcome the institutionalization of age old care. The regional priorities are:

- To develop innovative regional policies in close collaboration between the Central Directorate of Health and Social Inclusion and the Central Directorate of Education and Research in the field of quality of life of the elderly and people with disabilities in order to promote living at home and to reduce the risk of institutionalisation.
- To foster synergies across different domains by bringing together the main actors active in housing and ageing-related fields, from both the public and the private sectors.
- To finance the functioning of a regional PP network, through regional and European funds (2009–2013), on the following topics:
    1. Telehealth, 'smart homes' and AAL
    2. Housing and living spaces
    3. Social innovation

The measures under telehealth, smart homes and AAL are:

A regional public service project for telehelp/telemonitoring integrated with safe keeping of house keys and first aid, outsourced to a private provider. This project has assisted a total of 4251 persons. Telehelp has interventional operative centres and operates 24/7 to respond to emergency calls from the homes of the elderly at risk. The telemonitoring service is intended to keep the beneficiary company and to ensure social/health prevention and psycho-physical monitoring. Centre operators call beneficiaries at least once a week to interact and to ask them to test the Telehelp alarm device. The constant phone contact, which can be in the local dialects, allows for mutual acquaintance and encourages the users to trust the service, which is fundamental in the management of emergencies.

'Presto A Casa' (Back Home): A pilot project funded in 2009 to develop innovative models of temporary domiciles for users with sub-acute physical and sensory disabilities.
Partners: Municipality of Trieste, AREA Science Park and ATER Trieste (public housing institution) with the support of the Province of Trieste.

‘HELP KEY TV’: Valorization of the role of vulnerable persons, through the experimentation of a model that allows for dialogue among stakeholders, including an evaluation of the linkage with the programme *Cartella sociale* in synergy with ICT platforms.
Partners: Municipality of Pordenone, Polo tecnologico di Pordenone, Local Health Agency no.6 Friuli Occidentale; and different actorsof the welfare sector were involved.

EASYMOB is an AAL system. The project aims at providing informative assistance to people with difficulties on mobility in the environment with boundaries.The technologies used are IR, Bluetooth and NFC.
Partners: SOLARI Udine Spa, LUCI Srl, MoBe Srl, Università degli Studi di Udine, IRCCS Aviano, Friuli Innovazione, Polo Tecnologico di Pordenone.

EASYHOME: AAL user-friendly systems through the use of smart and efficient lighting devices.
The project aims at providing the possibility of using in a simple way the options offered by the ‘domotic’ system. Personalized domotic systems based on the specific needs of the users will be developed. The main element of this domotic system is light, not only used for its lighting function but also for its bactericide action.
Partners: CRP Centro Ricerche Plast-Optica, Elettra Srl, Electrolux Spa, Università degli Studi di Udine, ATENA Fvg Srl, Sipro Srl, MarMax Srl, Polo Tecnologico di Pordenone.

DREAMING: ElDeRly-friEndly Alarm handling and MonitorING
The project, started in 2008, foresees trials in six European countries (Denmark, Estonia, Germany, Italy, Spain and Sweden) supported by an integrated system providing vital and environmental parameters monitoring and videoconferencing services. This system is based on an existing technological platform, specifically designed taking into consideration the special requirements of elderly users who, during their active lives, have never been exposed to ICT.
•Partners: FVG Regional Local Health Agency no. 1 Triestina

Telemedicina (TELEMED): This project (introduced in 2009) provides support to a healthcare service sensitive at the users’ needs, to be delivered according to current protocols but able to go back to the clinical data, allowing for an improvement of the services perceived by the citizen that will benefit from appropriate care with intensive monitoring comparable to hospital service.
Partners: Aziendaospedaliero-universitaria ‘Ospedali Riuniti’ di Trieste, Teorema Engineering, Tesan Televita, Local Health Agency no. 1 Triestina.

RE-FREEDOM: based in Udine, foresees the networking of two apartments, structured to host research in new technologies and validation and testing of an organizational model for the provision of innovative services using advanced technologies. The project aim is to develop guidelines and tools for planning the refurbishment of housing units and also at the level of district city (2009).

Partners: Municipality of Udine, Rino Snaidero Scientific Foundation, Friuli Innovazione.

LAK (Living for All Kitchen): The objectives of this research project are:
- to demonstrate the innovativeness of kitchen environments integrating domotic technologies and new interface solutions for service delivery from a distance,
- to promote the autonomy of elderly people living in their own dwellings in terms of safety and comfort.

Partners: Snaidero Rino Spa, Sipro Srl, Inoxfim Srl, Teletronica Spa, Mediastudio Srl, Rino Snaidero Scientific Foundation, Friuli Innovazione, Area Science Park, Università degli Studi di Udine.

Ufficio H of the Piergiorgio Community Onlus: a 'Regional Competence Centre' for the promotion and facilitation of communication involving serious disabilities. This is a service acknowledged by law as a regional centre of reference for assistive technologies. It is an 'Institutional Info Point' for people with disabilities, their relatives and families; with a permanent exhibition of both technical-informatic aids and environmental accessibility for the disabled.

Under housing and living spaces, there are two pilot projects:

- Financial support to social housing projects (10) as alternatives to the institutionalization solutions for the elderly and people with disabilities.
- Experimentation with an evaluation system of' accessibility of buildings on the basis of the WHO-ICF approach in order to provide public authorities with an instrument to eliminate architectural barriers in public facilities where services are delivered. Preliminary results are expected at the beginning of 2012.

The measures for social innovation are:

- Strengthening/re-organizing home-based social and healthcare services according to a community development approach in which professional services are complemented by the promotion of social protection networks.
- Developing feasibility studies for PPP community foundations to take care of the elderly and people with disabilities.
- Support to fairs and exhibitions.
- Sharing experiences within European networks committed to healthy ageing (AER, ENSA-ELISAN, ERRIN, EUREGHA, CORAL).

The main barriers to implementing these measures are:

- Lack of knowledge about the complexity of the ageing phenomenon
- Fragmentation between public and private responses and resources to the needs of elderly and people with disabilities
- Separation between individual needs in specific context s(urban areas, rural areas, mountains) and marketed products and services, especially in the field of ICT and care devices
- Weak attitude to working in territorial partnership**,** in both the public and private sectors

In his closing remarks, Giulio Antonini anticipated the challenges ahead as:

- Wider knowledge about the role of ICT in promoting autonomy and independent living
- Integration of knowledge, resources and responsibilities in the responses to the needs of the elderly population and their families
- Definition of integrated local policies to oppose the marginalization and isolation of the elderly
- Conversion of care resources into investments aimed at social inclusion
- Innovation in the relations between the private and public sectors
- As a result of a joint planning including all the main regional actors active in R&D, to establish a regional platform, able to ensure continuous visibility and representation of the activities implemented, encouraging knowledge sharing, within and outside the regional system, awareness and general consent about the needs and the potential strategies to be adopted.

Experiences from Halland, Sweden – An ageing related initiative

by Ann-Mari Bartholdsson

Halland in Sweden is a small, wealthy region of about 300,000 inhabitants that has excellent healthcare and public health, a diversified economy with a very large proportion of small enterprises with few examples of large-scale deployment of AAL products and services.

In 2004 the Healthcare Technology Alliance was started as a non-profit association of companies, researchers and healthcare organizations with the goal of "Safe and secure at home" and user-driven innovation that contributes to an infrastructure for innovation and knowledge transfer. In 2009 the Health Technology Centre Halland was born with funding from European Union. It is a well structured programme with participation from healthcare organizations, trade and industry, municipalities and Halmstad University, which was the initiator. Through seminars, workshops and meetings, ideas were mooted that have led to the transfer of needs and knowledge from users to researchers and industry, and vice versa.

One example born out of this initiative is the Phoniro lock system. It is a solution for more effecient home care. The project was granted modest financial support from a governmental fund. The project lasted for a few years and the product was tested for a long time in the municipality, together with users in the form of home-help staff and residents. Some of the requirements of the product were:

- Invisible from the outside
- You don't have to damage the door, the lock can be removed easily when it isn't needed anymore.
- Secure
- Easy to handle
- In-and-out log
- Possible to make alarms smoother

The results achieved were:

- The elderly care organizations recognize the need for better tools: “Homecare 3.0”
- Access via keyless systems that is also integrated with information and documentation
- Established dialogue and cooperation between client/user and supplier
- Avoidance of logging in and out among many different administrative systems
- Home-care personnel participated in several workshops and have now created the ultimate system.

The Phoniro lock system was the start of a process where the staff in the care organization learned that they could take charge of their own development process and that they are the experts. Now they see the possibilities with this system and want to go further into a system that offers a solution to more needs than just key management and in-and-out logs.

The Phoniro lock system project thus led to new project, called Homecare 3.0. The requirement now is for a system that we see might be the start of a service platform where the local authorities can take charge of their own development and not be so reliant on the big players such as the international ICT companies that now rule the development of such projects totally. This thinking comes from the automotive industry where developers do not know today what information technology will be demanded in five years when the car will reach the market.

The user-driven experiences drawn from these projects are :

- *First*, to know who the users are and to identify their needs and preferences is quite easy in the beginning but it gets harder.
- *Second*, business models needs to be addressed early in the process.
- *Third,* the role of the facilitator is extremely important.
- *Finally*, the best results are reached when there are both companies and “market” involved from the start.

Barriers are :

- Needs must be clearly identified
- The complexity of needs *versus* willingness to pay
- Timing vs. rapid return on investments
- Lack of competence
- Lack of staying power due to limited capital
- No political governance outside the ordinary political boundries, i.e. elderly care.

Bartholdsson emphasized the need for interregional cooperation and noted that the few AAL solutions deployed on a large scale are proof enough of the need for more interregional cooperation in which the following has to be taken into account for success:

- Knowledge transfer
- Best practice
- Common standards
- Commersialization
- New political agenda

On the experience in Halland, the keys to success are; political backing and understanding, a forum where participants can meet, and focus on users.

SOCIAL Apulia: SOCial Innovation for the quAlity of Life in Apulia

by Adriana Agrimi from Apulia, a region in southern Italy

Running short of time and seeing the need to avoid repeating what had been said, Agrimi gave a brief presentation and asked the audience for ideas now that they had been familiarized with other projects.

The Apulia project is more inclined to policy formulation and especially welfare and social inclusion policies. Amongst them are:

- Social connectivity
- "Care Allowances", "Indirect Personalised Assistance" and "Projects for Independent Living"
- QUALIFY-CARE PUGLIA – support for social domotics
- ROSA project (Welfare Services Employment Network) – interventions to support care giving at home

With the Chair's agreement, Agrimi explained this AAL is in a preliminary phase and she challenged the audience to suggest the way forward. This elicited suggestions and turned out to be final discussion for the session (Session E3).

The following suggestions were offered:

- Development of more Living Labs.
- Development of better pre-commercial procurement instruments.
- Tenacity is required for AAL projects.
- A cross-cutting financial model is required for the participation of both public and private sectors and especially one that will bring insurance companies on board.
- National ministries under which these programmes fall need to be included in policy formulation and if possible all regions should be included.
- Development of legal generic instruments that clearly spell out the roles of both the government and private partners.

- Need to demonstrate sustainability in terms of finances and political governance for the justification of public funds.
- Hard evidence in terms of statistics and data needs to be collected and collated for clarification to political authorities. It would also come handy in budgeting.
- Develop models that would easily fit for replication in other parts of Europe. These models it was pointed out need to backed with strong data to avoid unnecessary pitfalls.

Finally the Chair, Peter Reymaekers, thanked everyone for their participation and asked them to put to good use the experiences presented.

SESSION E4: GETTING OLDER IN SOUTHERN EUROPE

Nathalie Hauk, Elisabeth Kastenhofer

As part of Track E, "European policy for ageing well in a global context", the present session addressed the issue of getting older in Southern Europe. The aim of the session was to discuss problems that the Southern European countries are facing and, more importantly, new solutions and opportunities to solve these problems. Sofia Moreno (Ametic, Spain) as chair opened the session with the question, "Do new solutions have to be technical solutions?" and pointed out that Southern European countries have less access to technological devices than other European countries. Therefore the focus must lie on a multidisciplinary approach and not only on technology. What the Southern European countries need are ideas!

The ideas and projects presented in this session addressed multiple approaches. Celia Gomez (Junta de Andalusia, Spain) promoted a user-centric approach, since patients and professionals are the end-users. She introduced several strategies for promoting active and healthy ageing in Andalusia, e.g. Health Responds, a call centre which provides health information and services. It is a service that is accessible for almost everyone and very easy to use. Another project is called Escuela de pacientes (School for Patients), which aims to empower patients and their carers and to promote social networking. Furthermore Gomez introduced another important aspect of health: Salud sexual, a programme to promote sexuality in the elderly population (e.g. workshops for older people).

Fabio Pianesi (Fondazione Bruno Kessler, Italy) promoted a territory-centric approach and the need for mixed models. He pointed out that solutions need to be tailored to the needs and demands of territorial characteristics. Projects should be designed locally from the start and need to be sensible to demographic regional differences (e.g. culture, income, economy). The main focus of AAL projects should be on services, not on technologies. To realize this approach, territorial labs (as an extension of living labs) are needed. The territory-centric approach has started already in some regions, where each region has its own research centre. Pianesi emphasized that not only should the end-user success be taken into account, but also self-sustainable business models should be created and tested before going on the market.

A project called AAL4ALL was presented by Filipe Sousa (Fraunhofer Institute, Portugal). It addresses the challenges of traditional health care systems in Portugal and Europe due to demographic and structural changes in the society and gives a solution to enhance sustainable economic growth in Portugal. By fostering senior tourism, social interaction with the local community could be increased, elderly people could be attracted to regions with a lower percentage of senior citizens, jobs could be created by promoting entrepreneurship in elderly locals (e.g. opening small B&Bs) and concepts like eHealth could easily be integrated and put into practice (e.g. automatic medical updates for the doctor at home during a long-term holiday). For Sousa it is important to create an interdisciplinary model and to include all relevant stakeholders.

Zoltan Lantos (GfK Health Care, Hungary) explained that the purchasing power in Hungary is much lower than the European average, although there is a huge difference between Budapest and the rest of the country. The biggest group within the consumer segment in Hungary are the so-called poor pensioners. Regarding their health consumption, AAL solutions should incorporate their peculiarities, their traditions and their financial situation when innovating new solutions, e.g. using television as a medium to bring the outside world to economically challenged seniors. In his opinion, a transformation of values is needed. AAL should focus on the sense of wellbeing of the people instead of focusing on consumption and function. Furthermore, future AAL projects should be aimed at active elderly people and concern social collaboration systems, especially in rural areas, using mixed, hybrid models.

The session concluded with a remark from a member of the audience (from Greece) pointing out that the elderly may not be the ones in need, but the ones with resources – namely time, financial savings and vitality. Seniors want to support their families and to participate in their everyday life. Elderly people need a task in life in order to feel functional, needed members of society and consequently to raise their wellbeing.

SESSION E5: SOCIAL INNOVATION IN ACTIVE AND HEALTHY AGEING

Hanriette Van Eijl
DG Enterprise, European Commission

There are very different forms of social innovation according to each country.

In every case, the question of impact is key.

Establish a link between business and social innovation.

Business	Social
New markets	Better public services
Jobs	Local needs
Production	
Global technology	

There are costs in making social innovation profitable/sustainable.

Idea Generation	5,000 to 10,000 €
1–2 year prototype	300,000 €
Implementation and scale	30,000 to 1 million €

Establishing a link means partnerships. There are four areas for new kinds of partnerships for co-creation by and with the end user:

- Care
- Host
- Excite: http://www.oru.se/English/Research/Research-projects/project/School-of-Science-and-Technology/ExCITE---Enabling-SoCial-Interaction-Through-Embodiment/
- E2C: http://www.e2c-europe.org

Mariano Navarro
Spanish Network of Social Space for Research and Innovation (SSRI)

AAL stays for Ambient Assisted Living, for which we can find many meanings.

Ambient	*Assisted*	*Living*
Home	ICT	Society
City	Relationships	Relationships
Region	Public services	Neighbors
Space	PPP	PPP
	Breaking barriers	Territory
	Social change	

It is important to distinguish living labs from SSRI.

The former is a test bed where companies try products. The second is an innovation ecosystem, which allows continuity in time and a social change.

For instance, social innovators in rural areas have over 20 years of experience: they can provide living labs with best practices and make synergies.

This means, that they can involve Ls in AAL projects for rural areas: we are talking about 15% of Europe's population.

Why do good policies fail? Take the example of leader funds. They have three pillars.

1. Competitiveness of traditional sectors
2. Improve environment of countryside
3. Quality of life and diversification of the rural economy

We found that pillar 1 was overbalanced and overfunded and this is why we propose to include the experience of SSRIs now in the EU projects in order to prevent again an imbalance. So, instead of smart cities, we should found smart regions. Because if we divide cities and regions we create a new barrier, and this is what AAL tries to prevent.

Can a shepherd, a peasant or a fisherman define complex ICT standard: yes, we do it for over 20 years and it works. So, let us work together without barriers. And let us work together with SSRIs and LLs.

Tuija Hirvikoski

European Network of Living Labs, ENOLL, Finland

We need social transformation; social innovation could be the initiator of a butterfly effect.

"Technology does not solve the problems, people do".

Example: if we do not change habits (smoking, health), doctors and engineers will fail.

Social innovation can support the design of ways to change habits

For instance: innovation with seniors has changed habits of older people at SeniorLab and Caring TV projects. In both cases the LL was rather a mind set, not so much a place.

EU projects should be more cooperative in partner countries, but in the framework: research + LL + SME + social innovators.

They should also go towards co-funding.

Joop Tanis

Young Foundation, UK

Young Foundation works with the power of connecting people. For instance, a start up project –a football based social integration charity- is connected to the National Health System.

We are what we share and collective intelligence is more than individual intelligence: people, not “users” inhabit the world and drive the innovation.

SWAP

Start with persons, not with services
Wellbeing matters
Assets based: what do we have, what do they already have
Prevention works better than crisis management

Questions to the speakers

How to scale innovation with the existing high barriers?

Hanriette van Eijl: There are two possible paths:
a) use the context approach with LLs
b) use the market approach with public private partnerships (ppps)

Tuija Hirvikoski: we have forgotten about what life is about: creating communities (people giving mutual support and meaning) costs virtually nothing. Examples: Okinawa (Caring TV) and South Africa (LL) examples.

Is the funded project the way for social innovation?

Joop Tanis: It is a good start, but social innovation has to be embedded in day to day life. Link social innovation projects with existing funding streams.

Tuija Hirvikoski: Why to get for more projects that change nothing? Instead: connect and integrate your social innovation into basic budget functions.

CONFERENCE POSTERS

SOCIALTV: SENIOR CITIZENS NOW HAVE THEIR OWN NETWORK

Ana Peñalver Blanco, Maite Gutierrez Cachán, Ana Isabel Arroyo Hernández, Juan Vicente Domínguez, Estíbaliz Ochoa Mendoza.

Abstract/Summary

The "SocialTV for 3G" project covers the definition, development and test of an application integrated into the user's home TV, offering a variety of features (including a Meeting Point and a multimedia Contents section), designed to promote social relationships among the elderly and providing quick access to information.

Figure 1: Required equipment for SocialTV

1. Introduction

In Spain, about 28% of the elderly frequently feel lonely, and this figure increases to 38% of those living alone (20% of the elderly). Feelings of loneliness may lead to problems of adjustment and self-perception, normally associated with the inactivity and isolation that might result in emotional disorders (anxiety, depression).

New ICTs, especially Internet social networks, have turned out to be very suitable tools in the maintenance and reinforcement of the social network. SocialTV is being introduced with the aim of reducing communication barriers between elderly people and their social environment, promoting a virtual "Meeting Point" where they can watch and talk to each other about their common interests. The expectation is that SocialTV will help prevent the appearance of disorders and deterioration associated with long-term feelings of loneliness and isolation, promoting communication between elderly people and keeping them connected to their reality and their environment through a wide band Internet connection and a simple and accessible platform integrated into their own TV set.

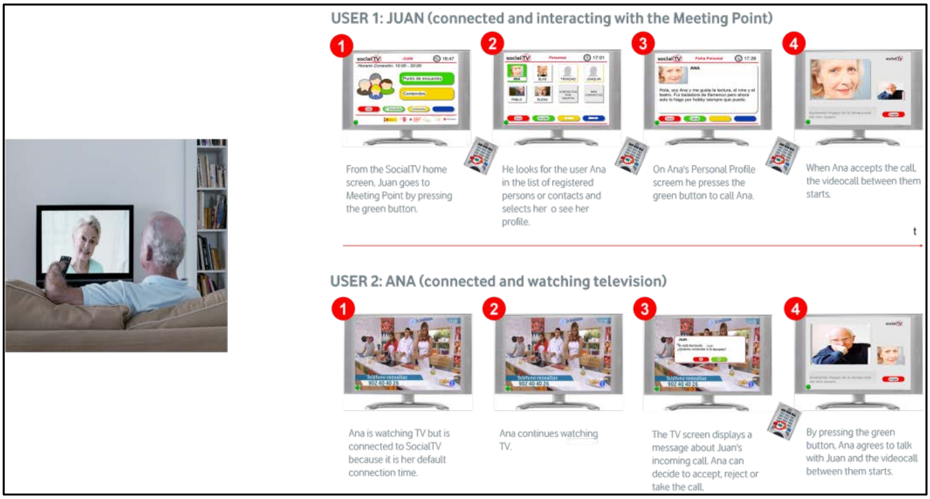

Figure 2: Meeting Point and operation

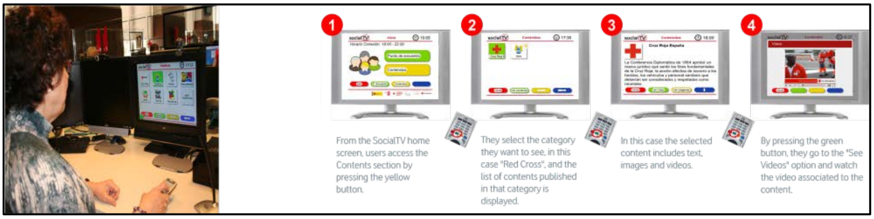

Figure 3: Contents access and operation

2. Methods

In the context of projects designed to promote e-inclusion, it is essential to rely on a development methodology that addresses all phases necessary to complete a solution that is oriented to the individual user. In the case of SocialTV, the methodology, applied throughout the project, uses the following sequential stages, which consider the role of the end user from the beginning:

1. First definition of design and functionality based on both Universal Accessibility and Design for All recommendations.
2. In-depth Interviews with 10 experts in elderly care (three Spanish provinces).
3. Focus Group of eight seniors who each meet the user profile, to define issues of usability, operation and aspects related to the interface design.

4) Usability Tests with five seniors to validate operation, interaction and accessibility.

All the information gathered from the validation of the SocialTV application has helped to develop the system that is currently being tested within the pilot phase (100 users are testing the solution in their own homes and Day Centres for nine months from March to December 2011).

Figure 4: Scope of the pilot test of SocialTV in Spain

3. Results

Following the completion of the pilot phase the assessments of the users, in terms of ease of use and utility of the platform, will be collected. These aspects will be assessed through pre-tests and post-tests based on the objectives of the project: improving welfare and reducing feelings of isolation and loneliness, demonstrating also the possibilities that new technologies offer in achieving these goals.

4. Discussion/conclusions

The technological solution of SocialTV has been built to bring the world of social networking to elderly people, and to do this in accordance with the needs and expectations that they express.

Based on the results of the pilot it will be determined whether this solution in fact meets its objectives and if the growth of social relationships it enables delivers better quality of life and promotes independence for the elderly.

Web Page: http://www.socialtv.es
Facebook: http://www.facebook.com/SocialTVpara3G
YouTube: http://www.youtube.com/watch?v=QVx4s7FU95M

Acknowledgements

This project is co-funded by the Spanish Ministry of Industry, Tourism and Trade within the "Plan Avanza" programme (TSI-040200-2009-59) and Wireless Reach from Qualcomm.

BEING THERE FOR THEM – A TELEPRESENCE DEVICE TO SUPPORT REMOTE SOCIAL AND CLINICAL CARE TO ELDERLY PERSONS

J. Artur Serrano[1], Stephen von Rump[2], Siri Bjørvig[1]

Abstract

Telepresence is a concept that, although not recent, still lacks a widely accepted definition. The concept is that a person is in some sense present in an environment that is physically remote from that person in space [1]. At the University Hospital of North Norway, the Norwegian Centre for Integrated Care and Telemedicine has established a cooperative arrangement with a company which produces such a system called "Giraff" (Figure 1). The system can be described as a PC running a videoconference programme fixed into a mobile cart. The cart can be remotely controlled to be positioned next to the elderly person. The GP can then communicate with the individual through image and sound, as the system is equipped with a screen, a camera, a microphone and a loudspeaker. The "Giraff" is available and in use in Sweden, Denmark, Germany, the UK, Italy and Spain, mostly within the elderly services provided by municipalities. The Giraff is being tested at Kroken Sykehjem, a nursing home in Norway. The test consists of regular doctor visits to the elderly people who are residing in the nursing home.

1. Introduction

The term 'telepresence' was first introduced in a 1980 Omni magazine article written by Minsky [2]. The definition of telepresence given by Sheridan [3] indicates that "the human operator receives sufficient information about the teleoperator and the task environment, displayed in a sufficient way that the operator feels physically present at the remote site."

The Giraff is being tested in a nursing home in Northern Norway (Figures 2 and 3) in a joint collaboration between general practitioners (GPs) and the public Home Care services. The Giraff allows caregivers with no prior computer experience to enter a home virtually and conduct a natural visit as if they were physically there (http://www.giraff.org/).

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[1] [1]NST - Norwegian Centre for Integrated Care and Telemedicine, University Hospital of North Norway

[2] [2]Giraff Technologies AB, Västerås, Sweden

Figure 1. Typical scenario for application of Giraff
Figures 2 and 3. Testing the Giraff

The Norwegian Centre for Integrated Care and Telemedicine is initiating the testing of the Giraff solution within a real-life context for elderly users, their relatives, professional caregivers and GPs.

2. Methods

The study's primary objective is to investigate if the use of telepresence visits will improve the current level of care while still maintaining or reducing the cost of care per patient at the nursing home. Important savings may be obtained by a reduction in face-to-face visits from informal caregivers and GPs to the nursing home, by making these visits virtually through telepresence. This technology allows for an increased number of GP visits, therefore improving the level of care, while reducing the costs associated with transportation and GP time on the one hand, and on the other hand also improving the quality of life of informal caregivers by allowing them more regular contact with the elderly person while not always requiring a physical visit.

3. Results

Current qualitative results are indicating a good user acceptance:

- From the elderly where the technology is perceived as simple, gives a feeling of privacy and is perceived as allowing them to retain control.
- From the professional caregivers, where the solution transfers some responsibility to the elderly (seen as the "Hands behind the back care"), i.e. some instructions can be given using the telepresence device, enabling the elderly person to execute a task (e.g. get the medicine), instead of doing the task for him or her. The professional caregivers also benefit from increased care participation by informal caregivers (family and friends).
- From the informal caregivers for whom the possibility of a visit from anywhere and anytime gives a sense of confidence and peace of mind.

Preliminary results have shown that that municipalities can save costs by using the Giraff for home care visits, as shown in Figure 4 (values in Euro).

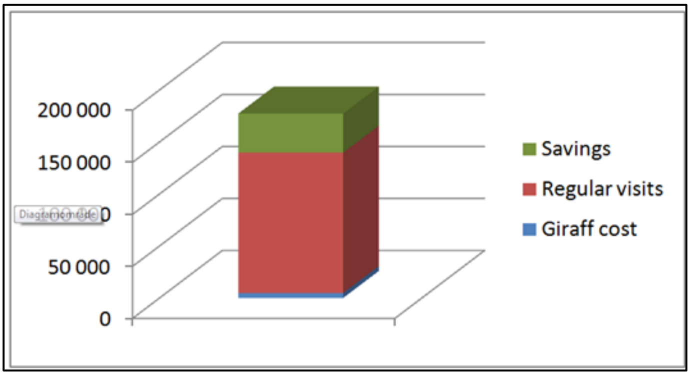

Figure 4. Giraff costs and savings

With the Giraff option, emergency situations can be avoided. Important savings are related to a reduction in emergency visits by the doctor. Savings can be estimated at €500 per year per resident. At Kroken Sykehjem, around 75 patients could be monitored by telepresence, yielding an estimated €37.5 K Euro in savings.

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VIDEOCALLING FOR MENTAL ILLNESS PREVENTION

J. Artur Serrano[1]

1. Introduction

The project will address the needs of elderly patients staying at home who have a tendency to strong depression and related mental illnesses. These patients become immobile, resulting from post-retirement situations where the pattern of living habits changes radically. Treatment for conditions in the mental health domain requires repeated and regular visits to a general practitioner (GP), a clinical psychologist or other health professional qualified to perform mental health clinical activity.

However, given the sedentary situation of most elderly people, it could prove extremely difficult to achieve a high enough compliance necessary for successful treatment within a mental health institution. It is in these circumstances that delivering therapy “at home” can play a role. There is a huge potential for telecare based on mobile devices due to the rapid decrease in the price of smartphones/pads. The use of mobile videocalling-enabled smartphones can deliver the therapy environment and the health professional directly to the patient.

2. Methods

Cognitive Behavioural Therapy (CBT) is the merging of cognitive and behavioural techniques in order to treat psychiatric disorders. Typically, CBT is focused on changing dysfunctional behaviour and the cognitions that help maintain this behaviour. It is an approach to therapy that aims to solve problems concerning dysfunctional emotions and behaviours through a goal-oriented, systematic procedure. The term is used to designate a therapy based on a combination of basic behavioural and cognitive research [1].

Regular interaction with health professionals could reduce the impact/duration of depression, consequently reducing the need for antidepressant medication. Thus, one outcome of this study will be an evaluation of antidepressant medication usage. A cost-effectiveness analysis [2] will be conducted to compare the new intervention with usual practice. Mobile phone usage, hospitalisations, medications, GP and psychiatric consultations will be measured.

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[1] NST - Norwegian Centre for Integrated Care and Telemedicine, University Hospital of North Norway

3. Results and discussion

The rapid market development in the provision of videocall-enabled mobile smartphones and pads has brought down the price of mobile videoconferencing to a level where it can be now considered for home private use. This opens an immense business market for the use of videocalling. A primary care service offered over the phone to depressed elderly patients could have an enormous impact.

The reduction in the consumption of antidepressives could compensate for the public costs of a mobile phone or pad-based solution.

We foresee the development of more and more "apps" for smartphones and pads relating to health. It is time for the public home care sector to consider the use of mobile applications for psychological health.

This project will provide 50 elderly users diagnosed with depression with a videocalling-enabled pad. The group will undertake an evaluation based on a behavioural change scale and will be compared to a control group under their current treatment as usual. The selection of users will be randomised.

The objective is to find out if the intensive use of CBT over videocalling can reduce the need for antidepressant medications for depression.

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HOME TELEMONITORING FOR CHRONIC HEART FAILURE

J. Artur Serrano[1]

1. Introduction

Providing patients with chronic heart failure (CHF) access to remote monitoring, such as telephone or telemonitoring using wireless technology, reduces deaths and hospitalisations and may provide benefits to health care costs and quality of life. Remote monitoring of patients can reduce pressure on resources, particularly for conditions such as chronic heart failure, which exerts a large burden on health services. These are the conclusions of a new Cochrane Systematic Review [1].

In Norway the costs of treating chronic heart failure are vast in respect of hospital treatment, daily use of medication over several years and loss of quality of life for patients and their family caregivers. Generally there is little knowledge about what is gained for the billions of krone used [2]. Advanced telemonitoring technology with electronic transfer of physiological data, such as blood pressure and weight, is currently being used in research and established routine services.

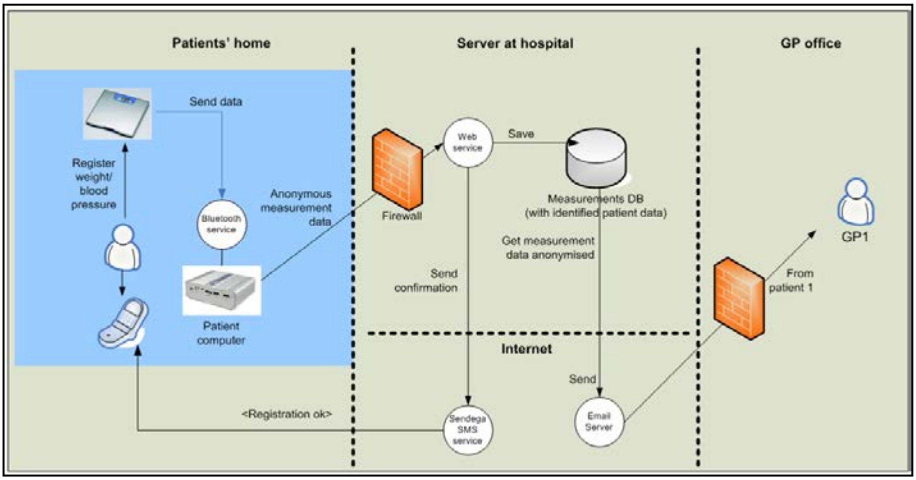

Figure 1. Home telemonitoring system architecture

[1] NST - Norwegian Centre for Integrated Care and Telemedicine, University Hospital of North Norway

The Norwegian Centre for Integrated Care and Telemedicine is initiating the testing of the Giraff solution within a real life context with elderly users, their relatives, professional caregivers and GPs.

2. Methods

The research project includes 50 patients in two groups (intervention and control). It consists of daily monitoring of the patients' weight and blood pressure directly from home, automatically and securely transmitting the values to a server in the hospital and monitoring the values at the cardiology outpatient clinic.

In order to understand how such services can move from being promising pilots to establishment as routine services in Norway, we also take into consideration previous results showing that issues regarding organisational arrangements and attitudes have to be resolved if implementation is to be successful [3].

The objective of this study is to explore whether, in comparison with current care provided by the heart polyclinic, the introduction of home telemonitoring will reduce hospital readmissions, and will additionally be cost-effective. Other goals are to measure changes in the quality of life for patients, and to assess the opinions expressed by patients and informal caregivers that may help in the development of new home telemonitoring health services.

A detailed cost analysis will address all costs associated with investment, operating, support and personnel within the RCT study.

The following data sources will be used: administrative systems at the hospital, the DRG system, number of readmissions, hospitalisation time and nursing time.

The volunteers are patients (end users) recruited from the hospital heart outpatient clinic. Half of the patients will be subject to telemonitoring and the other half will receive their usual treatment. The 'Minnesota Living with Heart Failure (MLWHF) Questionnaire' will be used to assess each patient's expression of quality of life. The questionnaire will be administered to the patients in both the intervention and control groups at the outset of the trial and after one year (study end).

3. Results

No project results have been yet achieved; however the following values are to be measured:
Primary outcomes:

1. expected reduction in CHF-related hospital readmissions, and
2. increased savings resulting from the service.

Secondary outcomes

- assessment of Quality of Life changes based on MLWHF (Minnesota Living with Heart Failure), and
- qualitative analysis of patients and informal caregivers opinions for identification of best practices for developing new home telemonitoring health services.

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MOBILE LEARNING REQUIREMENTS FOR OLDER PEOPLE WITH DIVERSE COGNITIVE SKILLS

Markus Garschall[1], Benjamin Wimmer[1], Bernhard Wöckl[1], Manfred Tscheligi[1,2]

Cognitive exercises are crucial not only for strengthening older people's cognitive capabilities but also for enhancing independent living. Moreover, positive effects on slowing the evolution of mild cognitive impairment (MCI), a pre-level of Dementia and Alzheimer's disease, can be achieved.

We investigated older users' needs and preferences towards mobile learning (m-learning). Results from two focus groups showed that older people have a very positive attitude towards the idea of an m-learning solution. By applying an alternative activity-oriented approach in combination with verbal and non-verbal evaluation methods, users' active involvement could be raised and led to a higher quality of outcomes than standard approaches, such as discussion groups.

1. Introduction

In the last decade e-learning systems mostly focused on younger learners, leading to a large number of systems that are applied at schools, universities or in the work context. Recent developments open up new chances for e-learning: learning processes are no longer location-dependent and make use of multimodal inputs and outputs in responding to the different skills of older per-sons.

The Training2Go project has developed an m-learning system addressing two main target groups: older persons interested in life-long learning and older persons suffering from MCI. The Train-ing2Go system offers older persons:

- A learning opportunity at anytime and anyplace
- A support tool for direct information exchange with other learners
- A personalised cognitive support and training tool easing the challenges of ADL (Activities of Daily Living).

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Starting with a requirements analysis, two focus groups were held with representatives of both target user groups.

2. Method

In the two focus groups, an alternative activity-oriented approach, in combination with verbal and non-verbal evaluation methods, was applied addressing the diverse cognitive skills of older per-sons with and without MCI.

Participants: 18 persons (12 female/six male) aged between 65 to 75, five of them suffering from MCI, participated in two focus groups. Focus group 1 comprised older persons interested in life-long learning. Focus group 2 involved people suffering from MCI. All participants were still living independently in their own households.

At the beginning of the focus groups, participants were introduced to the topic of m-learning, starting with a discussion on life-long learning and the importance of new technologies. Thereafter a brief description of the planned Training2Go solution was given.

Start your Day: Participants were asked to express their ideas for future application areas for the Training2Go system during a brainstorming session. In order to explore the different contexts (time and place), the “Start your day” [1] method was applied. Participants were asked to write their ideas onto ‘post-it’ notes and to place them on a pre-printed weekly calendar.

EmoCards: Thereafter, participants were presented three scenarios representing possible features of the future Training2Go system. Users were asked to rate their emotional response to the scenarios applying EmoCards [2], a non-verbal product evaluation instrument:

- Scenario 1: Communication with the trainer/carer
- Scenario 2: Learning together with others
- Scenario 3: User-generated content

Future Acceptance: In a final step, users were asked to complete a questionnaire regarding their acceptance of the future AAL solution [3].

3. Results

General results of the focus groups showed that both target groups have a positive attitude to-wards the idea of a mobile learning solution supporting older persons with and without MCI.

Potential Applications: For the prospective users, the most important aspect of the planned solution was its mobility. The main reason for using the system is to receive support in specific areas of life for which no similar tools are currently available (e.g.

in addition to course offerings or as a mobile support tool for cognitive training). While older people without MCI will use the system mainly for leisure activities (e.g. travel information, language courses), people suffering from MCI focus on its use for supporting ADLs (e.g. nutrition, health). In addition, participants suffering from MCI underlined the possibility of repeating learning contents as often as necessary without time pressure.

System Features: Three scenarios including the core features of the mobile learning system were rated by the users applying EmoCards [2]. Results confirmed the participants' positive attitude towards the features presented in the scenarios. Almost all ratings were within the positive range of the scale that can be interpreted as "pleasantness". In detail, "User generated content" was rated slightly better than "Learning together with others" and "Communication with the trainer/carer".

Future Acceptance: Both groups perceived the mobile learning system as rather positive. Only the aspect "self-reactiveness" is seen as less important. This outcome probably results from the fact that the benefits of Training2Go were only described in an abstract way. Further investigations during laboratory and field trials are planned to obtain a more realistic view on future acceptance of the system.

4. Discussion and Conclusion

Applying an activity-oriented approach various opinions, expectations and concerns of the prospective users could be covered. The "Start your day" brainstorming showed a high demand for a mobile learning system in a wide area of applications. While elderly people without MCI will use the system mainly for leisure activities and life-long learning, people suffering from MCI focus on its use for supporting ADLs. Applying the non-verbal evaluation tool EmoCards, users showed a positive attitude towards the core functions of Training2Go. Furthermore, results from the acceptance questionnaires confirmed the positive attitude towards the idea of the mobile learning solution.

Feedback gathered from the focus groups will be directly incorporated into the further development of the Training2Go system. Iterative lab and field evaluations will follow to validate the results from the requirements analysis and to enlarge the overall quality of the Training2Go system.

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OMNIACARE: PHR SYSTEM AND AAL PLATFORM FOR MOBILITY, HEALTH MONITORING AND REMOTE ASSISTANCE

Paolo Casacci[1]

Abstract/Summary

In the next decades, a constant increase in life expectancy is foreseen, with a consistent increase in services specific to the elderly.

Technology today can improve the quality of life for the elderly and people with disabilities, allowing them to continue to live at home and helping caregivers and family members in assisting them.

1. Introduction

OMNIACARE is both a Personal Health Record (PHR) system and a platform for Ambient Assisted Living (AAL), resulting from several research projects, that allows caregivers and family members to monitor and help elderly people without the need for physical presence and to remotely control their state of health.

2. Methods

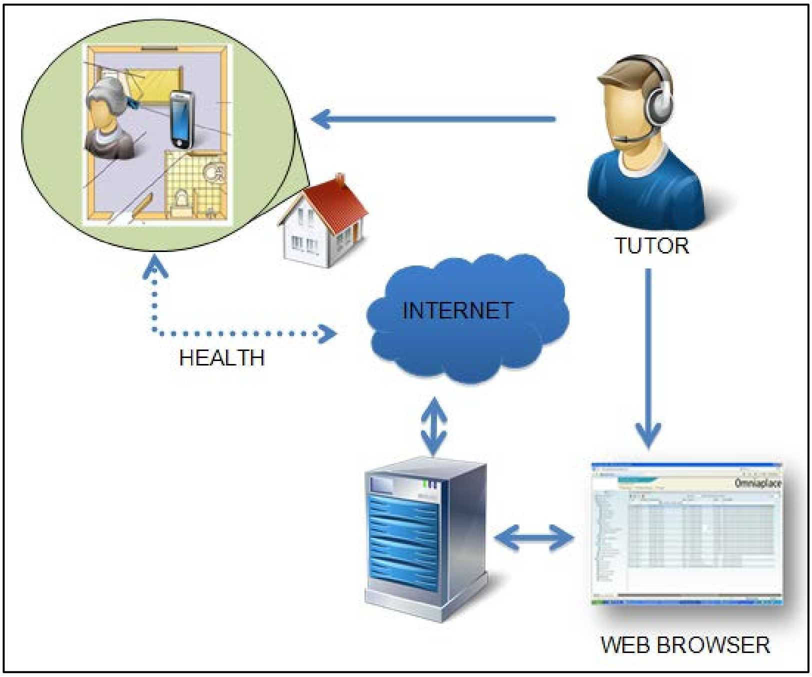
The software is based on a client-server platform on which elderly people's profiles are configured and services are activated with respect to their needs and personal situation. It is possible for caregivers to use the server platform to define activities to be performed (e.g. take medicines), environmental parameters to be monitored, messages to send (voice message, sound message, depending on the particular difficulties of the elderly person), the hardware to use to track vital parameters and known locations that can be reached.

Several devices can be used on the client platform, such as PDA, Tablet PC and wireless sensors. They can be used as stand-alone devices or in combination, in a modular way.

[1] eResult s.r.l.

Those devices can:

1. provide sound alerts or vocal messages to remind the user of the time of a specific job.
2. accept simple information in order to register when tasks have been completed.
3. monitor events, such as loss of any reply from the elderly person.
4. give information about the position of the elderly person using the integrated GPS receiver.
5. contact a caregiver or family member
6. provide step-by-step directions to guide the assisted person to preconfigured places.
7. detect clinical information.
8. detect critical situations, such as a fall.



3. Results

Data provided by the sensors are processed by a home server and stored on a central server. Clinical information is stored in the central server's PHR system. When a critical situation is detected, an email or SMS can be sent to a caregiver or family member and a WEBCAM can be activated to control the situation remotely.

A further important feature, under development, is the creation of an expert system for continuous life-sign analysis, capable of monitoring signals such as ECG.

Thanks to its flexibility and modularity, OMNIAPLACE can than manage very different aspects such as Mobility, Social Inclusion, Care and Automated Assisted Living.

4. Discussion/conclusions

Interactivity possibilities

The system was at first developed to be used by elderly people who are self-sufficient, or partially self-sufficient, and in general conditions of good health. The platform upon which it is based is very flexible and configurable and was realised with the aim of extending its usability to the whole category of "fragile" users, meaning users with handicaps or problems of drug addiction.

The system can be interfaced with virtually any device to track vital parameters, and is open to the possibility of data acquisition in a continuous and automated way.

Business case focus

The system is now in the industrialisation phase in order to achieve a product that can be put on the market. The product marketing considers that the cost of the system is at the moment not directly affordable by a significant proportion of elderly people, who have limited financial resources. In its first phase, the system will be targeted at social housing and cooperatives that provide care services, which will have the benefit of economies of scale to reduce costs, and will provide tutor services. In this first phase, support to the customers will be provided directly by eResult, but there are plans in the next few years to create a service centre located in the Puglia region to handle a large number of system installations and to train personnel in installing the system for the users and provide maintenance.

End user involvement

The OMNIACARE system was tested by volunteers in order to gather real-case data. Thanks to the collaboration with social cooperatives, several elderly people used the system over a period of days in order to verify the functionality and level of acceptance.

Different scenarios have been tested, including its use by people with difficulties in sight, hearing and dexterity.

New project results or findings in research

There are currently several research projects aiming to extend OMNIACARE capabilities. The most significant one aims to implement a continuous data acquisition and analysis system in order to make OMNIACARE suitable even for people who need specific health monitoring, such as people with cardiac problems. The objective is the creation of an expert system capable of analysing the data in real-time, to provide a reliable analysis and identify potential problems before they occur, as a form of pre-diagnosis. In the case of the system identifying a problem, the analysed data will also help the doctor to evaluate the seriousness of the issue.

Another project aims to provide services for inclusion, e-commerce and booking of services in collaboration with local social cooperatives.

JOIN-IN – SENIOR CITIZENS OVERCOMING BARRIERS BY JOINING FUN ACTIVITIES

C. Hildebrand[1], H. Demski[1], C. Duschl[2], W. Tiedge[3], S. Wengel[2]

Abstract/Summary

Join-In aims to support housebound elderly people in socialising. Technologies and methodologies integrated into everyday life offer the possibility to engage in social activities without leaving home. The research project uses different methods to investigate the interests of the very heterogeneous user group in order to assess the requirements for the assistive systems to be developed. First results of the analysis are presented.

1. Introduction

Join-In (figure 1) aims at providing the methodology and at setting up a social network for the elderly; it allows communication by either TV or PC. A multi-player serious game for the elderly is being developed, in addition to exercising either by exergames or by moderated exercises. Physical activity—besides supporting good health—counteracts feelings of loneliness, while loneliness in turn leads to less physical activity [1]. Recent results indicate that exergames create physical benefits and counteract loneliness [2]. Join-In wants to encourage contacts with peers in the region and with family and friends living further afield, if necessary facilitated by an assistant.

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[2] *Diakonie München-Moosach, München, Germany*

[3] *Pasife GmbH, München, Germany*

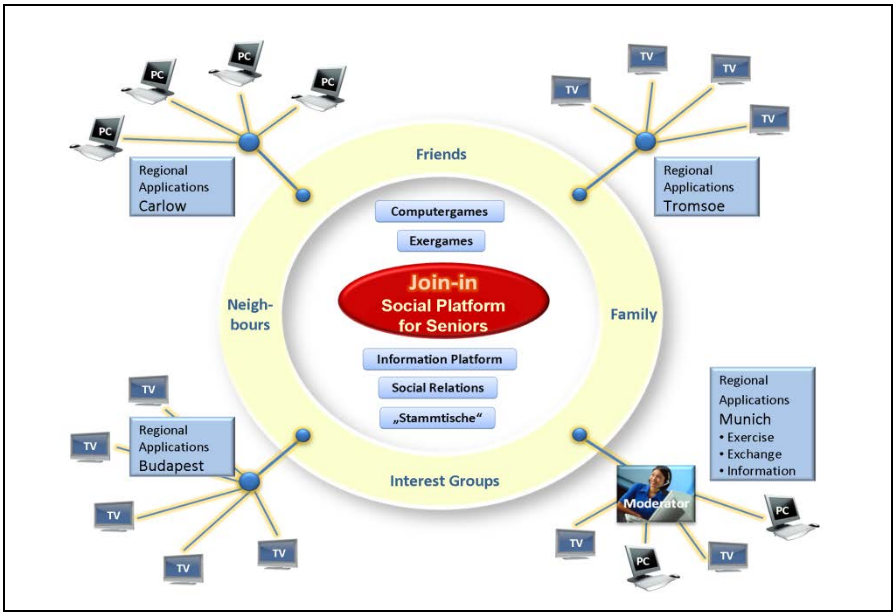

Figure 1. Join-In Platform

Loneliness in the elderly is a major problem in elderly care. Studies in Britain show that more than half of people over the age of 75 live by themselves [3]. Many of these suffer from loneliness and social isolation. Studies have shown there is a correlation between loneliness and poor health, especially effects on the immune system, cardiovascular system and the onset of Alzheimer's disease [4, 5].

The Join-In project aims at counteracting loneliness in the elderly by providing a concept, the methodology and technologies for elderly persons to participate in social activities.

2. Methods

Active participation is vital if the individual is to profit from the Join-In developments. Yet motivation in the elderly is a challenge. One of the problems is the heterogeneity of the target group.

A thorough user requirement analysis provides the basis for the methodology ("How can the targeted users be attracted to the social platform, its content and its applications?"), the virtual games, the exergames and the Join-In platform itself.

User groups were set up in Germany, Hungary, Ireland and Norway. The lead user group is based in Munich. Scenarios and personas gave a first insight into the users' lives. Research questions were defined covering the following aspects: gaming, platform, exergaming, exercising, interest and knowledge of technologies, quality of life. Questionnaires were designed.

The target group of the project comprises elderly people, especially those who are not able to leave their home. There is no clear definition concerning age. Seniors can be people starting at the age of 50, 60 or 65. Chronological age is not sufficient, yet it is an important distinction[1]. The data was analysed according to the following age groups: 56 to 65 years, from 66 to 75, from 76 to 85 and the category of people over the age of 85. It soon showed that in order to overcome fear of e.g. the new technologies, people have to become involved before they are housebound.

The German user group's main participants are between 70 and 90 years-plus. A number of regular group activities taking place on a monthly or even weekly basis were identified for gaining support for Join-In. There are, amongst others, (talking) clubs as well as dancing groups. Key persons turned out to be of special value. They communicate trust to the users and can moderate between the research team and the user groups.
To meet the needs of the research questions, a method mix was found to be most appropriate to gain an insight into the different social aspects that are dealt with in this field of work. Qualitative research methods help to capture the life world of the users from their perspectives. The research methods included guided and structured interviews, self-administered questionnaires and group discussions, as well as focus groups. Special board gaming sessions were set up to increase the interest in gaming and to identify likes and dislikes in games.

3. Results

First results show that of all the activities offered communication and fun are favourites with the users. Competition plays a minor role, although people like to win. Another important outcome is that the trust the users put in the research teams provides a major basis not only for overcoming their fear of the new technologies but also the vulnerability of the elderly people: many of the seniors stated that they were afraid of not being taken seriously and only being treated as "test cases" for the tools to be developed.

4. Discussion/conclusions

Studies show that people missing social contacts are more susceptible to diseases, to infarction and stroke. A virtual social network allows the elderly to stay in contact with friends and family. Yet, many elderly have no experience and little trust in new technologies and their own abilities in handling them. The Join-In analysis undertaken so far seems to emphasise that, in order to make sure that seniors will use the ready product, user involvement at an early stage is vital.

[1] Cp. Jakobs, Lehnen and Ziefle (2008), p. 15 and Bowling, See-Tai, Ebrahim, Gabriel and Solanki (2005), p. 487f. have shown that over half of the interviewed seniors felt younger than they were.

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INTRODUCING 3RD-LIFE: A 3D VIRTUAL ENVIRONMENT FOR SOCIAL INTERACTION OF ELDERLY PEOPLE

Buiza, C.[1], Yildizoglu, U.[2], Ozimek, W.[3], Kervina, D.[4]

1. Introduction

The main aim of the 3rD-LIFE project is to improve the quality of life of ageing people through a 3D virtual desktop environment, providing them with a tool for entertainment, education, communication and other functionalities. With only a computer and an internet connection, people aged between 60 and 75, without any specific cognitive impairment exceeding the expected level related to the healthy ageing process, will be able to communicate, make audio and video calls to external telecommunication devices from their own homes and using their own voices, and live a more joyful and active life because of the applications that will be implemented. The 3D environment will help the users to communicate in a "natural way" (the project will concentrate on user interface usability), through the well-designed virtual world and spatial navigation. This will differentiate the solution from the typical, portal-like 2D, text-based tools.

2. Methodology

The User Centred Design (UCD) approach will be followed throughout the development of the 3rD-LIFE project, involving user groups as much as possible in the design process. In the system, users will be represented by avatars, and therefore accessibility, usability and navigation will all be a central focus of attention. The main target group is people aged between 60 and 75 years and without specific cognitive problems. However, target users of 3rD-LIFE project are not only ageing people (primary users), but also the younger generation (secondary users) who the primary users would like to communicate and share with through the 3rD-LIFE platform. Apart

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from these, other potential users such as health care providers and other type of organisations (tertiary users) will be considered given their capability to use the platform for a better interaction with the people they are working with. The overall aim is to create a bridge over the "digital gap" between the younger and older generations.

The operative objectives of the project will be:

1. To develop a fully functional 3D computer simulation platform.
2. To design user interaction scenarios and user interfaces for the target user groups (elderly people, their younger friends and relatives).
3. To design and create the content of the platform within the 3D environment that will constitute the functionalities, visual aspects and interaction possibilities.
4. To include existing tools and applications (interoperability), through new adaptations to be used in the 3D virtual environment.
5. To validate the final solution using pilot testing in two EU countries to ensure reliability, usability and adaptability, according to the final users' needs.
6. To develop a detailed exploitation plan for the results of the project.
7. To disseminate the project results to final users, public administrations and the research community.

There are very few examples of 3D virtual environments designed specifically for the elderly. Related research is mostly undertaken in the context of rehabilitation and physical therapy, and in the field of computer game design. The target users will be active computer users, who are familiar with 2D navigation and online platforms; however, the primary target user group for the planned interface concept is mostly novice users. As a result, the requirements of a 3D virtual desktop environment for the elderly will be explored in detail, taking into account many different aspects from avatar design to control devices. Their preferences, likes, dislikes and needs will be sought and examined.

3. Expected results

The expected results of 3rD-LIFE project are the following:

1. Creation of an innovative ICT tool for elderly people for social interactions.
2. Innovative and enabling ICT technologies adapted for the elderly. A 3D solution developed based on existing collaborative platforms, virtual environments, e-learning tools and user interfaces.
3. The virtual environment will meet existing standards, as it will be based on the adaptation of existing solutions adapted to older people´s specific needs and preferences.

ACCESSIBILITY ISSUES @ WIKIPEDIA

Eduard Klein[1], Markus Riesch[2], Anton Bolfing[2]

The project's goal is to contribute to the improvement of the user experience of online community platforms; the special focus here is on improvement of MediaWiki[3], and specifically on accessibility issues for the Wikipedia.de platform. The accessibility experts of the Swiss-based "Access for All" foundation[4] have completed a report about accessibility issues based on the WCAG 2.0[5] guidelines from the W3C consortium. The report contains test results that have been recorded by a group of blind and multiple handicapped accessibility experts. Moreover, recommendations for improving accessibility for the Wikipedia platform are given.

Besides the classical test areas, which are partly covered by test tools and script code analysers, specific deficiencies of Rich Internet Applications (RIAs) are discussed, based on the Web Accessibility initiative and the WAI-ARIA documents[6] of the World Wide Web Consortium W3C, and suggestions for semantic structuring using WAI-ARIA and the HTML 5 landmark are given. Although there exist several web sites with Wikipedia accessibility issues[7,8], to the authors' knowledge this is the first time a systematic test based on acknowledged WCAG 2.0 guidelines in line with the POUR principles[9] has been carried out.

The tests have shown that the German version of the Wikipedia encyclopaedia is to a certain degree accessible for handicapped users based on the different quality levels defined in the WCAG 2.0 guidelines. Nonetheless, there remain many restrictions and barriers for handicapped end users and authors. Consequently, there is much optimisation capability for authoring tools concerning aspects such as the usage of semantic structuring, systematic use of shortcuts, correct use of lists, use of alternative representations and the avoidance of layout tables. The complete report is accessible on the website of the TAO project of which this accessibility study is part.[10]

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[3] http://www.mediawiki.org

[4] http://www.access-for-all.ch

[5] http://www.w3.org/TR/WCAG

[6] http://www.w3.org/WAI/intro/aria

[7] The meta wiki: http://meta.wikimedia.org/wiki/Accessibility

[8] The blind wiki: http://blind.wikia.com/wiki/Mediawiki_and_Accessibility

[9] Perceivable, Operatable, Understandable, Robust

[10] http://www.thirdageonline.eu

1. Methods

The project's roadmap consists of three steps: first, to assess the accessibility of the web site resulting in a report; second, the implementation of selected accessibility aspects within the MediaWiki, which is the underlying php-based wiki system for the Wikipedia platform; third, a comparative pre-/post-assessment is planned based on implementation of the former step.

The first step was accomplished by July 2011. The accessibility of the Wikipedia.de website has been assessed by a group of test subjects with and without visual and other handicaps. The test results are documented in a report that also contains recommendations for further improvement. The report has been handed over to the German Chapter of the Wikimedia Foundation, which is currently evaluating the report with respect to possibilities for launching appropriate implementation projects on the MediaWiki system.

The WCAG guidelines define three conformance levels, these being A (basic), AA (recommended) and AAA (advanced): a website can be certified against these levels. Wikipedia.de does not completely conform to one of these levels, but fulfils several criteria on all levels.

Each test criterion has defined test steps that are carried out by an accessibility expert supported by a series of specialised testing tools, by users of assistive technologies and through script code analysis. Technologies used are the screen reader JAWS[11], the zoom tool ZoomText[12], the colour contrast analyser CCA 2.0 and the browser plug-ins JuicyStudio[13], WAVE, Web Developer and the Accessibility Toolbar, as well as the HTML validator of the W3C, and a pdf accessibility checker PAC[14].

2. Results

In addition to the detailed test protocol, the report summarises the top 10 suggestions for accessibility improvement:

- Accessible CAPTCHAS
- Semantic structuring (structural headings, WAI-ARIA landmarks, HTML 5)
- Linked images (all images) must inform the reader about their contents (and the fact that they link to the media file page)
- Keyboard-operability (focus visibility, dropdown-menus, focus sequence) Correct markup of data tables
- No usage of layout tables
- Correct use of lists
- Implementation of skip-links and access–accessible keys

[11] http://www.freedomsci.de/prod01.htm

[12] http://www.aisquared.com/zoomtext

[13] http://juicystudio.com

[14] http://www.access-for-all.ch/ch/pdf-werkstatt/pac-pdf-accessibility-checker.html

- Error-Messages and Error Detection in accessible forms Skin with reduced complexity of user interface

In order that a screen reader can read a link to the user, it must be annotated with an explanatory text. There are many guidelines available for formulating good text alternatives for images[15], and it is recommended that authoring tools remind or even force authors and editors to fill the 'alt' attribute.

3. Conclusions

Many of the recommendations can also be found in the list of techniques for WCAG 2.0[16]. Our report emphasises the traceability of the requirements in mapping appropriate techniques to accessibility criteria, and is complete with respect to the WCAG 2.0 criteria.

As often is the case, open source projects suffer from missing developer resources. As an example, one recommendation of the report is the usage of audio CAPTCHAs as an alternative representation, and there already exists an implementation for the MediaWiki system produced by a team of the Carnegie Mellon University (see: the blind wiki URL). Until now, however, it has not been integrated into a release version because nobody has yet put the work into its implementation.

The report also gives specific hints for modern web techniques such as HTML 5 and Rich Internet Applications (e.g. based on Ajax and push technology), which are not covered by the WCAG 2.0 guidelines, but are nowadays widespread in many online community platforms.

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[15] http://www.cs.tut.fi/~jkorpela/html/alt.html

[16] http://www.w3.org/TR/WCAG20-TECHS

SMART ARM SUPPORT SYSTEMS - SHARING THE EFFORT –

Emilia Motoasca[1], Bob van Ninhuijs[1], Elena Lomonova[1], Paul Verstegen[2], Dick van der Pijl[2]

Abstract

To increase the level of independence of movement-impaired persons, electromechanical assistive devices for various purposes have been developed. Arm supports are an important class of assistive devices, since they provide support in most daily routine activities. The commercially available arm supports nowadays still have some restrictions and limited functionality. In designing novel arm support systems to be used both as assistive devices and as training devices, the use of more advanced actuation techniques has to be considered as an important part of the system design. In this paper, the technical specifications of the actuation techniques to be used in a novel smart armrest are discussed.

1. Introduction

Impairments of the upper limbs caused by neuromuscular diseases and aging affect a large number of people, who then become more dependent on their caregivers. Most of the commercially available electromechanical assistive devices that can compensate for movement impairment are mechanical devices that completely take over the functions of the affected limbs, without supporting or enhancing the remaining limb functions. Design of novel arm supports that allow most of the activities of daily living are essential for independent living of elderly, motor-impaired persons. Such devices will allow motor-impaired persons to 'do things on their own', in a healthy, active life supported by novel technologies.

A recently started project of a Dutch consortium of industry and academia has been proceeding towards the development of a smart armrest, to be placed on a conventional wheel chair, as an assistive device for people with reduced arm functionality. The novelty of this armrest it is that it will provide both enhancement and training of the still existent arm functions and, at the same time, it will be easy to

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use, cheap and flexible, and the user will therefore be motivated to use it either for daily life activities or for training purposes.

2. Methods and results

In general, smart arm support systems should have an operation adapted to the actual needs of the user, should not restrict the use of the remaining arm functions and should provide support only for those movements the user cannot perform. At the same time, a smart arm support should also allow training and maintenance of retained arm functions. A smart system such as this requires an optimal combination of passive and active actuation strategies, resulting in flexible, programmable and easy to control (via user-friendly interfaces) actuation to provide the necessary gravity compensation and realisation of the human arm movements.

In the design of the armrest system, converting user needs and wishes for the total system to the technical requirements of the actuation mechanism is an important issue. Since all movements of the armrest will be realised via the actuation mechanism, this should be possible without using bulky, expensive and power-consuming components.

In this context, the investigation of possible solutions for the actuation of the shoulder joint of the arm support took as its starting point the conversion of the motion range of the human arm, as presented in Table 1, into the technical specifications for an electrical machine to be used as an armrest actuator. During daily activities, the user should be able to lift a small object. This has also been taken into account when determining the most suitable actuation. For the simplified case of an armrest, as presented in Figure 1, an electrical machine placed at the shoulder joint can be designed so that it is able to lift the armrest together with the small object. These results have been further used in the design of a spherical actuator that can mimic the shoulder joint of a human arm. Next steps concern the actuation mechanism of the elbow joint, followed by the design of the control system.

Movement	θ_{max} [°]	θ_{min} [°]
Shoulder extension/flexion	-30	140
Shoulder adduction/abduction	0	140
Shoulder lateral/medial rotation	-50	80
Elbow elbow extension/flexion	0	130
Forearm supination/pronation	-30	80

Table 1. Range of motion for the armrest

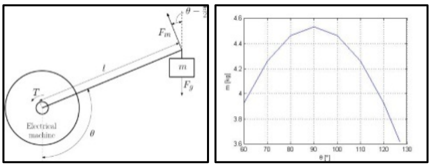

Figure 1. Model of an armrest and the weight lifted by it

3. Discussion and conclusions

The goal of the project is to develop a smart armrest that provides support for daily activities, but which does not however take over the complete arm functionality. The development of such a smart armrest is heavily influenced by the design of its actuation mechanism. In a smart actuation mechanism, the user should form the feedback loop of the system and the provided actuation should be matched to the actual needs of the user. The design of an optimised actuation has to be based on a specific set of technical specifications obtained from the user requirements. Extraction of the technical specifications from the user requirements is not trivial, since one design has to fit all users, while not all users have the same requirements of the system. However, if the armrest can also be used for training and rehabilitation purposes, more requirements need to be taken into account. The results have shown that it is possible to determine the range of motion required by the user in their daily routine. The necessary range of motion found must then be converted into technical specifications. With these technical specifications, the complete actuation mechanism can be further designed.

HEALTH@HOME: LESSONS LEARNED AND FUTURE PERSPECTIVES IN THE HOME MONITORING OF PATIENTS AFFECTED BY CHRONIC HEART FAILURE

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Abstract

Among chronic diseases, Chronic Heart Failure (CHF) has recently been attracting the attention of physicians and administrators, as it represents one of the most frequent causes of hospitalisation, with a consequent considerable impact on patient quality of life and healthcare costs. This paper presents an integrated ICT solution to improve the management of CHF patients through the monitoring of vital signs at patients' homes.

1. Introduction

Chronic Heart Failure (CHF) represents one of the leading causes of hospitalisation among chronic diseases, especially in patients aged over 65 years, with a consequent considerable impact on patient quality of life, resource congestion and healthcare costs for the National Sanitary System. CHF actually affects around 15 million Europeans [1] with an incidence of 3.6 million of new cases every year but, considering the general aging of the population, these data will double before 2035, leading to a collapse of the medical facilities.

Healthcare expenditure on CHF accounts for 2% of the total healthcare budget [1] and approximately 75% of such expenditure is due to hospitalisations [2]. CHF has a

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progressive evolution, with a variable duration depending on the severity of clinical status at the time of the diagnosis. It is associated with a one year mortality rate of 10%, 20% and 40% for patients in New York Heart Association (NYHA) classes II, III, and IV respectively.

The current healthcare model is mostly in-hospital based and consists of periodic visits, including vital signs monitoring. Unfortunately, periodic visits do not allow early detection of exacerbation, leading to a large number of re-hospitalisations. Studies have highlighted that for inpatients with a discharge diagnosis of heart failure, the probability of a second hospital admission in the following 30 days is about 0.25%, with an admission rate of up to 45% within six months [3]. In addition to the important problem of the worsening quality of life of patients and their relatives, the re-hospitalisations lead to high congestion in specialised centres and pose a financial problem to the National Health System.

The characteristics of the disease show changes in vital signs before aggravation becomes irreversible, and therefore almost continuous monitoring would ensure early diagnosis and treatment, reducing avoidable hospitalisation. This regular observation cannot be undertaken at medical facilities due to the high costs and the lack of resources. The use of ICT to monitor a patient's parameters at home, together with the support of a healthcare provider, significantly improves CHF management, ensuring the opportunity to collect vital parameters daily and automatically send them to the medical centre, where are analysed. Home monitoring may have an important role as a strategy to provide effective and cost efficient health care services for CHF patients. There is some evidence that a multidisciplinary management programme and home-based intervention can reduce avoidable hospitalisations in heart failure patients. Home care monitoring may have an important role as a strategy to provide effective and cost efficient health care services [4].

The Health at Home project (H@H) represents a complete and integrated ICT solution to improving the management of CHF through the remote monitoring of vital signs at patients' homes, enabling in-hospital care of the acute syndrome to connect with out-of-hospital follow-up. The new home care model allows the medical staff to monitor patients at a distance continuously, decreasing the time taken before action in the case of destabilisation (early diagnosis and treatment).

2. System Overview

The requirements of the system were derived from a close collaboration between physicians and technical partners, taking into account the characteristics of the disease and the peculiarities of the patients, to fit both medical and patients' needs and expectations. For the physicians, the telemonitoring system must not be an excessive overhead with respect to their regular activities; on the other hand, the impact on the patient must be minimal. For these reasons we propose a system directly integrated with the Hospital Information System (HIS) based on an Operating Protocol (OP). The OP consists of a set of actions that the patient must follow during the monitoring. The

OP can be customised depending on the patient needs and possible disease evolution, if necessary. The actions are simple tasks such as taking measurements or replying to simple questions.

The system has the typical client/server architecture (see Figure 1). The client side is located at the patient's home and consists of a home gateway and a set of biomedical sensors. The server side, installed at a health service facility, accepts and processes data from gateways making them available in the Hospital Information System.

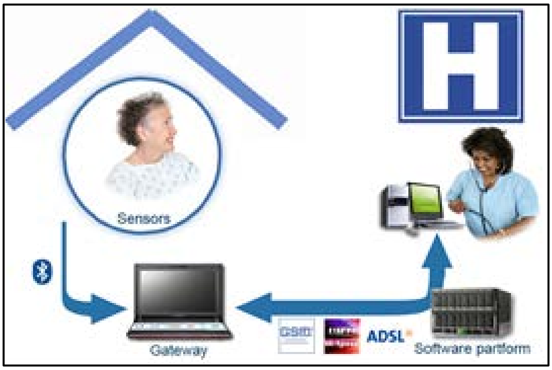

Figure 1. System Architecture

Bluetooth technology has been chosen for the communication between sensors and gateway, due to the wide diffusion of available devices on the market that integrate such a protocol. On the other hand, ADSL is the primary transmission channel for data communication between the gateway and the server, and in this case mobile broadband (GPRS/UMTS) is used as a secondary data channel. Redundant access technologies ensure flexibility and fault tolerance. Furthermore alert messages are sent as SMSs directly to the physician, patient's relatives and caregivers.

3. Sensors

Table 1 shows the features of the sensor devices and the composition of the basic and advanced version of the system.

Table 1 Sensing module devices

Parameters	Sampling	Basic	Advanced
3 lead ECG	500 S/s/lead (12 bit/S)	♦	
SpO2	3 S/s (10 bit/S)	♦	
Blood pressure	1 S/type (32 bit int)	♦	
Weight	1 S (32bit float)	♦	
Chest imp	25 S/s (10 bit/S)	♦	♦
Respiration	25 S/s (10 bit/S)	♦	♦
Posture	3 axes * 1 S/s/axis (8 bit/S)	♦	♦

Basic partitioning is intended as the minimum set of requirements to achieve a complete and useful telemonitoring system. Advanced partitioning refers to additional features in order to widen the kind of patients that could possibly be enrolled into the telemonitoring. The basic configuration involves three sensors: A&D medical UA-767BT arm cuff device for blood pressure, A&D medical UC-321PBT digital scale for weight, and ECG-SpO2 device produced by CAEN-IT for acquiring synchronised 3 leads ECG and SpO2 traces.

4. The Operating Protocol

The OP describes the behaviour of the home gateway in terms of types and frequencies of measurements, transmission policy, selectable symptoms, comparison thresholds, etc. An example of measure frequencies and ranges for alarm detection is shown in Table 2.

Table 2 The Operating Protocol

Data	Schedule	Alarm level
3 lead ECG	1-2 / day (5 min)	50 < HR <100 bpm
SpO2	1-2 / day (5 min)	> 90%
Blood pressure	2-3 / day	85<sys<160 mmHg 50<dia<100 mmHg
Weight	1-2 / day	Gain < 1 kg/day Gain < 3 kg/week
Chest imp	1 / day (5 min)	Fluctuation < 30%
Respiration	1 / day (5 min)	12 < R < 25 bpm
Posture	continuous	No activity / fall
Therapy reminder	1-2 / day	3 faults in a week

5. Communication

The remote collection server is implemented as a webservice; HTTP protocol messages are used to transport service requests and responses, which are further encapsulated using the SOAP protocol. As data exchanged between the gateway and server involves the public Internet, the HTTPS protocol uses HTTP messages over an SSL channel established after certificate validation, fitting completely the requirements of confidentiality, authenticity and integrity for the data traffic and the webservice interaction. The request message sent by the home gateway at any transmission time contains all the patient data (vital signs and events) mapped with HL7 CDA standard blocks, while the response includes the actual XML operating protocol description.

6. Conclusion

The paper presents an integrated platform provided with software tools and technologies for telecare of CHF patients. The system supports the whole process of the patient treatment connecting in-hospital care with out-of-hospital follow-up by patient / family, with specialised nurses and giving a direct link with specialists. The use of international standards for data exchange improves the interoperability favouring the integration / interaction of the system with any other HISs or biomedical sensors, as long as they are standard-compliant. Moreover, the high degree of configurability of the operating protocol represents a key element in terms of effectiveness of the whole system.

A technical validation of the system was performed involving 30 patients with CHF disease in NYHA class III and IV. A specific testing protocol and a questionnaire have been developed to gather feedback from patients, caregivers and physicians. During the demonstration phase, the H@H care model was strongly appreciated by both physicians (for the effectiveness of the telemonitoring) and by patients (for the continuous follow-up at their home).

Finally, it represents a promising opportunity for managing the increased number of patients expected for 2035, especially if an e-Health scenario is widely accepted by physicians and the hospital information system is developed accordingly.

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ACTIVITY ANALYSIS WITH SENSOR FUSION AND HIDDEN MARKOV MODEL

GuoQing Yin[1], Dietmar Bruckner[1]

Abstract

In an AAL project, an activity model of the elderly should be built based on data from different kinds of sensors that are installed in the user's living environment. Furthermore, any unusual activities of the user should be detected according to the model. In order to find the relationship between the sensors, and to build the activity model for the user, sensor fusion and a hidden Markov model were used. At first, sensor data were correlated to determine the relationship between sensors, and then a hidden Markov model was used to detect abnormal daily activities of the user.

1. Introduction

Because of aging processes, some elderly people can become disrupted by movement or memory disorders in their daily life. Sometimes it is difficult for them to use equipment properly to obtain help when required. In particular, in extreme situations, for example if unconscious, it is impossible for them to press an alarm button to get help. In an Ambient Assisted Living project ATTEND (AdapTive scenario recogniTion for Emergency and Need Detection), we avoid use of sensors that are worn on the body of the user. Furthermore, nothing is activated by the user in the case of an emergency. Here only non-intrusive sensors such as a motion detector, door contactor and pressure mat are to be used.

We gathered data from the sensors for a few weeks in order to build an activity model for the user. As some elderly users have a stable lifestyle and living habits, and because the activity model is a direct reflection of their lifestyle and habits, so the activity model is also stable. The stable activity model of the user forms the basis of detecting unusual activities of the user, within a reasonable time. Furthermore, the system will send an alarm signal to the caregiver when unusual activities or an emergency has been detected. In order to build the activity model of the user, sensor fusion and a hidden Markov model are employed.

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2. Methods

Sensor data correlation was used in order to determine the relationship between different kinds of sensors. For example, there are sensor values from sensor $X=[x_1,x_2,\ldots x_n]$, and sensor values from sensor $Y=[y_1,y_2,\ldots y_n]$. The values formed a paired sample $(x_1,y_1), (x_2,y_2),\ldots, (x_n,y_n)$. From the mean value μ_x, μ_y, variance value σ_x^2, σ_y^2, and covariance value σ_{xy}^2 we obtained the correlation coefficient between X and Y: $r_{xy} = \sigma_{xy}^2/.$. The correlation coefficient value indicated the relationship between the sensors.

Using a hidden Markov model, the daily activity model of the user could be built. A hidden Markov model can be characterised by the following parameters: the number of states N; the number of output distinct observation symbols of each state M; the state transition probability distribution matrix $A = \{p_{ij}\}$; the state emission probability distribution matrix $B = \{b_{ik}\}$; and the initial state distribution $\pi = \{\pi_i\}$. Based on the parameter λ (π , A, B) with forward algorithm ($a_1(j) = \pi(j) * b_{jt}$ for $t = 1$ and $a_t(j) = b_{jt} * \sum_{i=1}^{n} (a_{t-1}(i) * p_{ij})$ for $t >= 2$), the probability of an observed sequence $Q^{(t)} = \{q_1, q_2, \ldots, q_t\}$ could be determined. If a probability value outside of the predefined intervals occurs, this means that the user has performed an unusual activity. Here i, j are different states, k is the number of output symbols, and t is the count of state sequence.

3. Results

Figure 1 indicates the sensor data correlation result in the user's living environment.

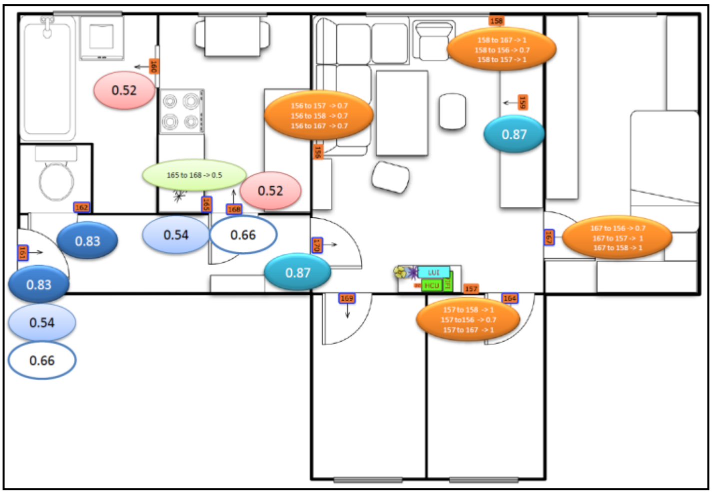

Figure 1. Sensor data correlation in user's living environment.

Sensors are installed in the living environment of the user. Most of the sensors are multi-sensors, each including a PIR sensor, door contact, acceleration sensor, temperature sensor and light sensor. These sensors send signals to a controller at different time intervals when they receive information from the environment.

Correlation will be used to determine the relationship (dependence) between these sensors. Figure 1 illustrates the result: for example, the entrance sensor has a correlation with the WC sensor. When the user goes to the WC, the PIR sensor of the entrance sensor detects the user's movement and the acceleration sensor of the WC detects the vibration. So, the two sensors are correlated. The sensors in the kitchen, living room and bedroom have different correlation values.

Figure 2 demonstrates the sensor logarithm value of each state. Here the value is the probability of observed sequences which compare with the built model.

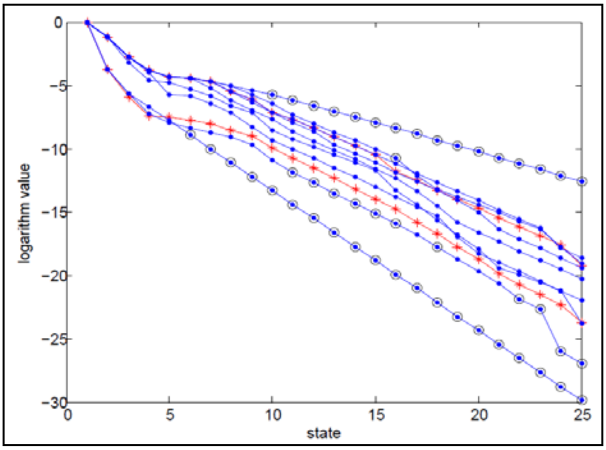

Figure 2. Sensor logarithm value of each state

Sensor data from a period of seven days has been used for training, and has been tested with another set of seven days (and two additional states series, one including all activities and the other without activities). The red lines are minimum and maximum training results from the training data. The blue lines are the test results. The values outside of the red lines should be treated as dangerous state values (with circle around point). The top and bottom lines with circles are the values from the two additional states series (without and with activities).

4. Discussion

The above introduced sensor data correlation and hidden Markov model are useful for building an activity model of the user and analysing activity. The stable lifestyle of the user forms the basis of a useful model.

DEMENTIA EXPERIENCE: IMPROVING CARE AT HOME

Jan Rietsema[1], Paul Bogerd[1], Ben Janssen[2]

Summary

Dementia Experience [1] aims to foster understanding by allowing people without dementia to experience through a simulated environment the reality, emotions and feelings of someone suffering from dementia. This will give carers -formal and informal - better understanding of this disease and will enable the provision of better, and less taxing, care.

1. Introduction

According to the website of Alzheimer Nederland [2] there are currently 270.000 people living with dementia in the Netherlands. This number will have increased to 500.000 by 2050. Seventy per cent of those living with dementia have three informal carers. The percentage of people living with dementia at home will increase. Home is usually the environment preferred by the patient and the number of nursing home places will not increase because of budget limitations and a shortage of staff.

To help people with dementia to live at home for longer we need to look at informal carers as well as the patient. Caring for a family member or neighbour living with dementia is a heavy burden. Research from NIVEL [3] in collaboration with the Dutch Alzheimer Association (Alzheimer Nederland) among about 1500 informal carers indicates that over 20% of carers are already overburdened and even more run the risk of being overburdened. Informal carers run four times as high a risk of depression as non-carers because of an extremely high burden of care. Moreover, carers of people living with dementia for a long time show serious reduction in their own social network. Dementia Experience will decrease the burden of care by allowing people to experience the various symptoms of dementia, followed by coaching.

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2. Methods

The aim of Dementia Experience is to foster understanding by allowing people to experience through a simulated environment the reality, the emotions and the feelings of someone suffering from dementia. 'If you have experienced what it is like to suffer from dementia, you understand it more, and can therefore offer better care, and that care will become less taxing for yourself'.

The core of the experience is a dementia simulator. This simulator is an interactive space in which the visitor experiences what it is like to suffer from dementia. In the interactive space, the visitor is part of a scenario of daily life. Various symptoms of dementia, such as amnesia, apraxia, disorientation in space and time, etc., are part of this scenario. These simulations of symptoms are partly in the real world and partly virtual reality and gaming technology.

Before visiting the simulator a short intake will prepare the visitor for her/his task. Afterwards s/he will receive a follow-up that has a coaching character (Figure 1). Ideally the Dementia Experience follow-up will form part of more intensive carer support (e.g. case management).

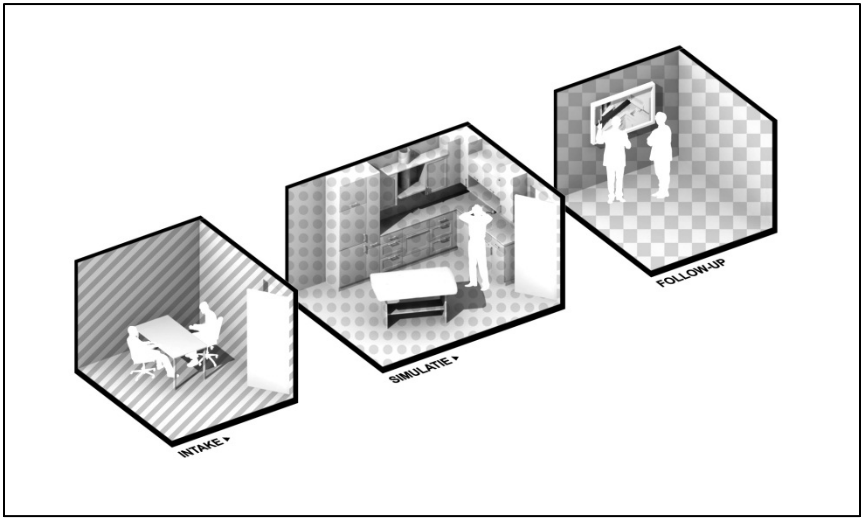

Figure 1: Schematic drawing of the three steps of Dementia Experience

3. Results

The most important and measurable change caused by a visit to Dementia Experience including the follow-up coaching sessions is a better understanding of the person living with dementia by family members, neighbours and other community members. Better under-standing will increase their empathy with the person with dementia. This was proven in an empathy study performed by Tilburg University as part of the Dementia Experience feasibility study [4]. Greater empathy causes a decreased stress level and a decreased burden of care. Better understanding also means that it is easier to talk about dementia in one's social network and improve the support it offers. Isolation from their social network is a huge problem for informal carers. Greater empathy will also improve the relationship between the person living with dementia and her/his carers and contribute to the well-being of the patient.

4. Discussion/conclusions

Simulation of a cognitive disease is very innovative. Simulation of physical disabilities is much easier and is often used to train healthy people and to create awareness. For relatives and other carers of people living with dementia, Dementia Experience can be seen as a training tool. In addition to the target group described above Dementia Experience will be used for the training of care professionals and care professionals in education. Dementia Experience, however, is useful for all professionals working with people living with dementia, e.g. taxi-drivers, podiatrists, etc. For the general public it is a tool for creating publicity and awareness, and contributes to the multi-age society, because it fosters better acceptance of the dementia phenomenon.

Acknowledgements

Dementia Experience is an initiative of Minase Consulting and De Wever and has been realised in cooperation with Tilburg University, Free University Medical Centre Amsterdam, Foundation Ideon, Care-centre Elde, Gleijm & van der Waart and IJsfontein Interactive Media. Realisation of Dementia Experience is part of the IAB-4 programme and partly financially supported by the Province of Noord-Brabant and Midpoint Brabant.

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GRID, CLOUD AND PICTURE-DRIVEN COMPUTING IN ICT ASSISTIVE TECHNOLOGY: NEW CONCEPTS AND MARKET IMPLICATIONS

Silvio Bonfiglio[1], George Kourousias[2], Fiorenza Scotti[3]

In recent interdisciplinary work on a novel computing paradigm we introduced a set of both technical and theoretical ideas in the field of assistive technology. The novel paradigm was that of *picture-driven computing* in the form of a programming system called Sikuli. We found that the very high computational requirements of its broader class of AT applications would be difficult to meet with smartphones and tablets. Such computing devices are becoming popular and their use in AT is wide-ranging. In order to compensate for their low computational abilities, we examined ways of outsourcing the computation and data storage in remote systems. We looked beyond the standard cloud solutions towards the older and scientific computing-oriented grid. This study has resulted in a critical view of various technologies from the AT perspective and has introduced new theoretical concepts like that of metamodalities for better description of the research.

Assistive technology can be seen as a specialized sector inside every single technology-related discipline rather than as a scholarly field per se. This specialized sector aims at providing some form of assistance to the large groups of people in great need of it. At the same time there are technologies that could be used for such purposes but fail to reach the AT region as they are attracted by more popular segments of the market. We recently identified such a technology and attempted to utilize it in AT.

In the broader human-computer interaction field a novel computing paradigm has been introduced that is based on images such as foundational data blocks. This new paradigm can be described as *picture-driven computing*. A programming system based on such principles has been implemented for automated testing of graphical user interfaces. It is called Sikuli [1] and we recently evaluated it and suggested its potential use in assistive technology [2]. Because it is a development system, Sikuli could enable a new set of AT tools that are difficult or even impossible to implement with existing technologies.

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In connection with the theory of multimodality such an approach could engender new modalities by automating and scripting existing ones. We call such modalities *metamodalities* and we encourage the further exploitation of what is already available (Figure1).

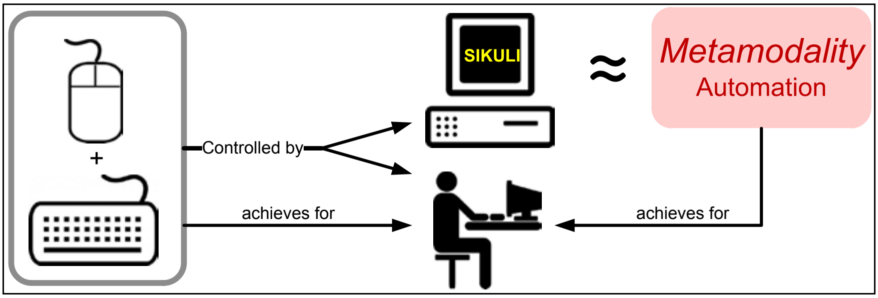

Figure 1. Sikuli as a metamodality: a new modality making use of existing ones.

The picture-driven system that we examined is computationally demanding owing to its computer vision algorithms. Portable computing devices like smartphones and tablets have lower computational power in favour of higher battery life. Such devices are becoming popular and because of their portability their use in the AT market segment is very high. In order to deploy them in advanced but computationally demanding systems changes are required on both the software and the hardware side. Instead of changing the hardware we consider options whereby the computation and data storage are *outsourced* to remote systems over a network. Specifically we envisage a unified computing paradigm where grid and cloud can serve AT purposes [3]. We propose the deployment of AT software *as a service* [4], and have designed a way to use Sikuli by performing its computationally expensive parts on a remote system.

The results of this work strengthen our view that there are many technologies which with little effort could be adopted for specialized use in assistive technology. This may require a more user-centric development approach and a better understanding of accessibility and usability theories.

Future plans include cooperating with specific user communities on additional elaboration of both technical and theoretical aspects of the above-mentioned topics. The parties involved so far shared perspectives from industry (BARCO), private research (Synchrotron Radiation Facility Elettra) and academia (University of Trieste). Continuation of the work could be sought in collaboration with EU projects.
We would like to acknowledge the catalytic influence on this work of the Master programme in Assistive Technology of the University of Trieste (Department of Engineering) that has served as common ground for the exchange and development of ideas on relevant topics.

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BUILDING BETTER BONES THROUGH BETTER CONVERSATIONS

Division of Bone Diseases - Faculty of Medicine - University of Geneva, International Osteoporosis Foundation

First online and in-person social network for people concerned with osteoporosis, friends, families and healthcare professionals.

In 2009, the International Osteoporosis Foundation (IOF) conducted a multinational survey to investigate existing gaps between physician and patient understanding of osteoporosis. The findings revealed problems in communicating and understanding what it is like to live with osteoporosis and revealed clear disparities in patient and physician perceptions of osteoporosis, indicating a need for increased patient support. Findings also showed that patients feared fractures, yet their compliance with treatment was poor. Most patients expressed the need for easy-to-understand materials and more interaction with their physicians and with other patients. In addition, physicians agreed that osteoporosis organisations were among the most credible sources for information [Rizzoli et al. (2010) Arch Osteoporos 5: 145–153].

To help address these gaps in communication and respond to needs expressed by patients, IOF, in partnership with the University of Geneva (Switzerland), developed the OsteoLink project, a new community-based initiative.

The first two pilots were launched in December 2010 in Sweden and Austria. As at August 2011, Austria had received 4,006 visits from 291 cities and 93 active users. Sweden saw 3,395 visits from 262 cities and 130 active users. Over 30% of OsteoLink visitors have returned more than 15 times. Discussions focus on prevention, research and healthy living.

OsteoLink (figure 1) is led by collaborative task forces of IOF members (about 200 societies worldwide, including 87 in the European Union), to ensure each community relates to the local needs of people with osteoporosis, their culture and their language. The task forces create OsteoLink (online and in-person) networks that best suit the needs of the osteoporosis community at the country level. The project is funded by grants from the EU and the Swiss Confederation through the Ambient Assisted Living (AAL) Joint Programme on Research, Amgen (Europe) GmbH in collaboration with GlaxoSmithKline (GSK), and other partners.

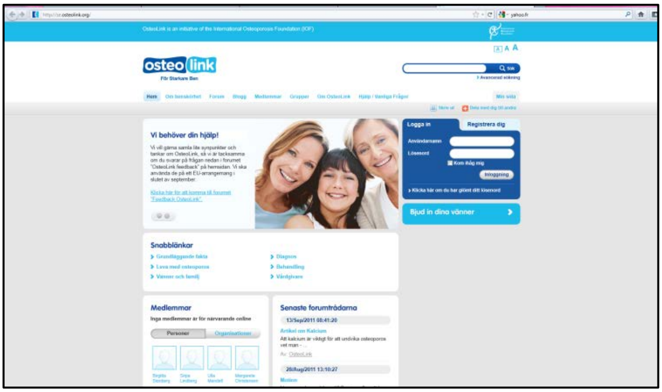

Figure 1. OsteoLink

OsteoLink's global media launch in March 2011 attracted nearly 200 osteoporosis societies and 27 journalists, whether in person or via webcasts. By the end of 2011, OsteoLink platforms were live in Australia, Germany, Greece, Portugal and Switzerland, and in France and Spain by early 2012.

Communities take time to develop. Once a critical number of users have been recruited sites tend to grow exponentially. Encouragingly, figures from both pilot countries show high engagement on the part of those visiting the site, highlighting a real need for a platform like OsteoLink, regardless of whether internet usage is high (Sweden) or low (Austria). OsteoLink activates engaged members to identify and motivate others.

Useful Links

More information on: http://www.iofbonehealth.org/patients-public/osteolink.html
Visit OsteoLink at www.osteolink.org

USER INVOLVEMENT AND SYSTEM ADAPTABILITY

Lenka Lhotska[1], Jan Havlik[1]

1. Introduction

On the basis of our experience of previous projects and development of applications for elderly and disabled people we believe that the most important issue in AT and AAL is active involvement of potential users. In the case of long-term monitoring the possibility of the application of adaptive systems should be considered. The systems can be personalised because they learn from the data of a particular person. The idea is to recognise changes in the health state and cognitive abilities of the potential users. From our point of view, the following issues are important: higher involvement of potential users in the development process; education of the users (showing them that technology can help them and they need not fear it); harmonising technological solutions with legal and ethical regulations.

2. User Involvement

If we plan to offer and test new technological solutions for improving the quality of life of older and challenged people, they should be low-cost and easy to use; they should provide entertainment and healthcare functionalities, support people's independence at home with tele-assistance, e.g. from local public services. The optimal solution could combine tele-medicine, tele-assistance, tele-entertainment and tele-company into a federated internet-based system usually intended for three very different and complementary groups of users: the customers (elderly/handicapped people who need some sort of support), their caregivers (e.g. organised in public or not-for-profit services) and health professionals (medical doctors and nurses). Each of these groups requires/ensures a specific type of service and consequently the developed system should provide them with group-specific access rights.

The design must consider the different types of users who could potentially use the system. Because these systems will be in use for longer they should be designed as easy-to-use, plug-and-play systems which can be easily customised to the needs of the individual user by modification of the guaranteed services for several types of application scenarios. For example, the system focused on the elderly can use three basic scenarios. The simplest base-level scenario is intended for a vivacious elderly

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person who requires no extra services but could benefit from more social contacts: this level includes communication and tele-company through a low-cost PC and open-source internet-based software. The intermediate level is complemented by simple sensors (e.g. to measure the ambient temperature) for the management of generic monitoring situations (e.g. very hot periods in the summer). Finally, a tailored upper-level scenario assumes that there will be particular health-monitoring sensors depending on the health profile of the user. Moreover, this most complex level has to be ready to create, send and handle an alarm signal generated automatically when the monitored signals of the patient meet certain predefined conditions. Different types of scenarios are to be defined for other groups of potential users, such as disabled people.

User interaction with such a system is not only a technological phenomenon but also has many psychological aspects, which we discuss in the next section.

3. Psychological Issues

We humans have unique experiences, background knowledge, and emotional and psychological history, and demonstrate acceptance and perception of other humans in a wide variety of ways. Unsurprisingly attitudes vary towards high-tech installations, especially in our homes. As we are so different, it is difficult to design a general system that is readily acceptable by everybody. Therefore a lot of research must be done in interaction with as large a group of potential users as possible. These users must be selected from a large and varied population, i.e. city/village, healthy / motoric disabilities / visual impairment / hearing impairment / cognitive disorders – all on different levels, male / female, different age, different experience with technology (none/weak/medium/intensive). The key issue is also proper design of the experiments – real-life scenarios. In this respect, the popularisation and introduction of these topics to public awareness and the possibility of visiting such model homes are options that can make this technology more familiar to the wider public. The designer must obtain a thorough understanding of the users, their disabilities, their environments, and their problems. The greatest challenge for the designer is not solving the problem but understanding it. User evaluation is an essential tool for obtaining proper understanding. Technology developed for use by lay users must have a control or user interface that is easily accessible, usable and useful in terms of its intended users. Therefore a user-centred design process must be used.

In the development phase it is highly advisable to use the tool known as the Virtual Usability Laboratory for software development [1]. Such a tool is designed to monitor users of web-based applications remotely and unobtrusively. At the same time the tool allows questioning of users after their interaction with the application. After experiments in which a large number of users have tested the application the usability data are collected and analysed. These data contain, for example, browsing patterns, system invocations, and user interactions. A similar approach is used in the standard Usability Laboratory [2], where tangible devices and tools are tested on all aspects of their design, i.e. functions, ease of use, ergonomy, safety, and demands on cognitive and motoric abilities.

4. Conclusion

We have tried to address some of the technological and psychological issues that must be solved in the future. The technological developments of recent years have included many innovative sensor systems, devices and tools that can be utilised in the area of AAL. System integration, however, has not been fully resolved. In this paper we have not focused on the technological issues but have tried to identify at least some non-technical problems linked to the introduction of technology allowing continuous monitoring of people's health and activities at home. We have shown that before such systems are implemented it is necessary to perform a detailed acceptance study and subsequent evaluation. The aim is for the lay users (mostly elderly people or people with impairments) to be willing and able to use the technology without difficulty. Designers and developers should bear in mind that the design must be user-centred.

Acknowledgement

This work has been supported by the ENIAC JU Project MAS 'Nanoelectronics for Mobile Ambient Assisted Living (AAL) Systems', its Czech co-financing No. 7H10019 and the research program No. MSM 6840770012 of the Czech Technical University in Prague (both sponsored by the Ministry of Education, Youth and Sports of the Czech Republic).

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AAL4ALL: A UNIVERSAL CARE SYSTEM FOR THE AGEING SOCIETY IN PORTUGAL

Filipe Sousa[1] and Liliana Ferreira[1]

Abstract

Developed societies in general, and Portugal in particular, are currently facing severe demographic changes: the world is getting older at an unprecedented rate. New challenges will be raised to the traditional systems of health care, which will compel the need for innovation in integrated care delivery. This article briefly describes the main challenges related to the current ageing society, particularly carers, and the efforts being undertaken in Portugal to address this problem.

1 Introduction

Portugal will face severe problems as a consequence of demographic change. The decreasing birth rate, reflected in the statistics provided by the Portuguese National Statistics Institute since 1974, has been accompanied by an increase in the number of people with physical limitations, which together with the isolation of those in rural areas represents a severe social and healthcare problem. In order to address this problem, society has to take action, accept ageing as a process throughout life, and focus more on prevention.

The increasing number of people with physical limitations and chronic diseases is not reflected by the number of formal carers, however. Current statistics predict a reduction in the availability of these professionals, causing the French Federation of Private Employees (FEPEM) to estimate that there will be a need for 20 million informal carers in Europe by 2025 [1]. Often, informal carers support elderly dependents at great cost to themselves and with inadequate support from community services. Only a strong investment in new research activities, focused on the development of user-centred services and products, will ensure and improve the quality of life of these carers by assisting them in their daily tasks. The development of innovative integrated care delivery systems will also facilitate the sustainability of care.

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2 AAL4ALL offers an answer

AAL4ALL is a project that is currently being developed in cooperation with 34 Portuguese interdisciplinary partners, ranging from industry to academia, R&D and social disciplines. The goal of the project is the mobilisation of an industrial ecosystem of products and services (shown in Figure 1) in the area of ambient assisted living (AAL), and focused on the definition of specific standards. The project started by specifying the requirements of users and informal and formal carers by means of dedicated inquiries. These data will be used to understand how ICT technologies are already part of the daily activities of these target users and to define new markets for care products and services. A special focus of the project is on the needs of informal carers, and their awareness of how the new technologies can help to improve elderly and chronic disease patients' quality of life. The expected results are the identification and characterisation of the adopted AAL solutions and their acceptance by users and carers. This procedure will allow the development of a user-centric model, capable of answering their needs while ensuring optimal integral assistance and improving the quality of life and the well-being of individuals and their carers.

Figure 1: Ecosystem of products and services

3 Conclusions

At a time when Europe is facing sovereignty debt crisis, there is a need for the implementation of more competitive policies and efficient management of existing resources. There is an evident need to choose the path of creativity and innovation in order to discover new ways to contribute to the prosperity and well-being of European citizens [2].

In response to population ageing and the declining number of health professionals, governments need to provide a clear definition of health and wellness and social policies focused on prevention. Social security systems and national health services need to be administered more efficiently and with fewer resources, both human and financial. On the other hand, private institutions play a major role in this direction. Insurers might offer products and services for the management of health and well-being of individuals. A cost decrease can only be achieved through better management of health, and stronger focus on people's well-being and healthier lifestyles. The development of AAL solutions is therefore essential in this new pattern of social behaviour, with active participation in the process by all stakeholders.

Finally, this investment in the promotion of greater independence of European citizens and development of AAL environments also implies the integration of informal caregivers in the process. Only an integrated vision of care delivery systems, promoting policies targeted at carers, can lead to better quality of life.

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AGNES, USER-SENSITIVE HOME-BASED SYSTEMS FOR SUCCESSFUL AGEING IN A NETWORKED SOCIETY TECHNOLOGY TRENDS AND NEW OPPORTUNITIES

Michele Capobianco[1], John A. Waterworth[2], Soledad Ballesteros[3], Christian Peter[4], Gerald Bieber[5], Andreas Kreiner[6], Matthias Muhlich[7], Lazaros Polymenakos[8], Sophia Wanche-Politis[9], Igone Etxeberria[10], Tomas Hedström[11]

Abstract

Research into ageing and cognition has demonstrated the close relationship of sensory functioning and social communication in maintaining cognitive performance and mood in the elderly, yet in modern societies elderly people are increasingly isolated and under-stimulated, both physically and psycho-socially. This situation results in accelerated cognitive decline and the suffering associated with loneliness and confusion. The AGNES project is developing solutions to keep the elderly mentally and socially stimulated and in contact with others by combining state detection and social network technologies. This paper provides some background on the approach and describes the technological concept of the project.

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[6] Modern Families gmbh, Linz, Austria
[7] CanControls, Aachen, Germany
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[9] Kendro Merimnas Oikoyennias kai Pediou (KMOP), Athens, Greece
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1. Introduction

Population studies point toward an increasingly ageing population. The ratio of workers to pensioners is shrinking significantly and people are living longer and having fewer children; in the future, people will have less familial care and support in old age. The AGNES project is a response to the growing number of elderly people living alone in their homes but in need of both social and practical support to maintain their daily activities and a good quality of life. Currently, they often suffer from social and physical isolation and chronic effects including cognitive decline, mild dementia, low activity levels and poor mood states.

The main objectives of AGNES are to prevent, delay and help to manage common chronic conditions of the elderly, so as to improve and maintain the well-being and independence of those wishing to continue living in their own homes – as well as to reduce healthcare costs. To achieve this, advanced but increasingly affordable home-based technologies are being developed and integrated, stimulating the elderly person and connecting them with family, friends and carers in new ways. Areas of research include psychology of ageing, activity detection, emotion recognition, social networking, and tangible and ambient interaction. AGNES will provide significant new knowledge on the potential of new technologies to delay, help to deal with, and even prevent common chronic problems experienced by the elderly population.

2. Method

A number of technology trends are enlarging the opportunities to create 'user-sensitive home-based systems': (1) the internet will soon be available on every device, (2) RFID capable devices, (3) automatic context awareness, (4) integration of services, (5) increased networking capacity, (6) broadband communication is becoming more and more available at the home, but also on wearable equipment, (7) the rise of robotics, (8) advanced recognition of user states, i.e. feeling, emotions, (9) integration of entertainment devices, (10) simple authentication systems, (11) communication capabilities in home artefacts. Phones and smartphones in particular are emerging as a mobile caring platform. Healthcare applications for mobile phones, smartphones and tablets are emerging that also serve as optimal platforms for reading sensors and foster interaction.

At the same time it is worth mentioning that more people, including the elderly, are using social networks. More and more people are using social networking tools (such as Facebook,Twitter, etc.). Most social network users are younger people but the number of older Facebook users is growing. In general, the new generation of elderly people are very open to advanced technologies. In the context of AGNES a specifically customised and personalised social networking tool named Modern Families is being developed, customised, and integrated with the functioning of ambient devices and state detection tools.

The project as a whole takes a holistic approach, in which several different technologies and devices are integrated to provide solutions aimed at the needs of the individual elderly person, as well as secondary users such as formal and informal carers (including family members and friends). These include:

- A social networking technology platform specifically designed to meet the needs of, and be usable by, the elderly person, and providing a communications channel through which people and applications communicate.
- Innovative technologies for the unobtrusive detection of user states and activities, based on inexpensive mass-market components such as web-cams, mobile phones, and tablets.
- Ambient devices for the display of information and events and for easy interaction with home-based systems and connected others.
- Diverse applications specifically aimed at the needs of the older person, to help deal with, or even prevent, the mild cognitive impairment/dementia that tends to be a chronic and worsening feature of this user population.
- Features that also support the need of carers, both formal and informal, for information about the older person, their activities and their current health state.

3. Discussion

AGNES provides a user-sensitive home environment that supports personalised and person-centric care. Through detection of the subjective states and activities of the elderly person, better-tailored and more timely attention and care can be provided. Exploiting the power of a dedicated social network means feelings of loneliness and insecurity are reduced and social and cognitive activities encouraged. Potential users are involved at all stages of the project, actively contributing to the processes of design and innovation. All implementations are being extensively tested for practical, social and psychological impact and effectiveness, often in real users' home situations. AGNES is developing systems and devices that can be turned into useful and usable products within two years of project completion in 2012, using a highly modular technical strategy.

AGNES's technologies and services have a strong market potential. One challenge in the AAL market addressed by AGNES is the need for universally designed products and services, filling the needs of broad ageing groups and achieving high market penetration. At the same time these groups have particular needs that can only be addressed by specialised technological developments such as AGNES. As part of the exploitation activities potential markets are being investigated with a focus on B2B customers (including national healthcare services and private health insurers as part of healthcare in general) and B2C customers (including individuals or private companies striving to improve the well-being of elderly and disabled people).

Acknowledgement

AGNES (AAL-2008-1-014), http://agnes-aal.eu/, is a project funded under the Ambient Assisted Living (AAL) Joint Programme, a new joint research and development (R&D) funding activity implemented by 20 European Member States and three Associated States with financial support of the European Community based on Article 169 of the EC treaty.

ACHIEVING ELDERLY SAFETY AT HOME BY AUTOMATED FALL DETECTION WITH STATIONARY INSTALLATION FOR INDEPENDENT LIVING

Ahmed Nabil Belbachir[1], Tommi Lunden Everon[2], Peter Hanák[3], Frank Markus[4], Mathias Krause[5], Tuija Mannersola[6]

1. Introduction and Methodology

Europe is ageing. The percentage of the population that is 65 years or older and human life expectancy are rising. The number of elderly people will be more than double by 2050 and the proportion of people living alone will increase. One of the highest risks for elderly people living alone or spending much time alone is falling down and being unable to call for help, especially in the case of loss of consciousness. The main challenge in installing ICT-based monitoring systems is keeping a balance between surveillance and privacy, i.e. home safety versus ethics. Hence, because privacy is a fundamental human right, any means for augmenting detection of critical situations in the living environments of elderly people need to respect and ensure privacy. Falls can occur in all home locations and situations. Wearable tools currently used for monitoring elderly people are often disposed in such situations, rendering them of little use for detecting potentially hazardous situations. As a consequence, 'smart ambient' approaches, like vision-based surveillance, appear to be more appropriate for that purpose.

The project CARE, running under the AAL-EC joint programme, aims to realise an intelligent monitoring and alarming system for independent living of elderly people. Specifically, this project targets the automated recognition and alarming of critical situations (like fall detection) applying stationary (and non-wearable) technology and real-time processing while preserving privacy and taking into account system dependability issues, especially reliability, availability, security, and safety ,from a holistic perspective. A biologically-inspired dynamic stereo vision sensor from AIT is

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being integrated into the Everon caring system for seamless analysis and tracking of elderly people at home. This real-time information is exploited for incident detection (e.g. fall detection, immobilised person), and instantaneous alarming of the concerned parties.

2. Results and Outcomes

In the early phase of the project, it was necessary to conduct interviews with end-users, collect a list of needs and identify the most important safety-relevant situations encountered. More than 200 end-users in Austria, Finland, Germany and Hungary were questioned. These end-users agreed on the definitive need for a fall detector at elderly people's homes and that the actual fall detectors (e.g. wearable systems) are not satisfactory and do not have high acceptance in the independent living context. Based on these interview results, a list of requirements was created for the CARE ICT system with a focus on fall detection as the main target. Architecture for a biologically-inspired stereo vision sensor was designed and the sensor and algorithms for the detection of falls were developed. The first installations of the CARE system are currently being tested and evaluated in Germany. Figure 3 shows the visual data from the CARE dynamic stereo sensor, which do not correspond to an image but to scene dynamics (ensuring privacy). On the left, the instant acquisition of the fall is recorded in an image-like representation. The right figure shows the 4D representation of the fall (space and time). The depth is colour-coded so that with rising distance between the object and the sensor the object is shaded darker (from green to blue). The person walks away from the sensor and falls after 9 sec in the same direction. Therefore the colour of the data points representing the person decreases over time from bright to dark blue.

The CARE concept mainly targets single individual elderly people living in their own private homes, so its market potential is huge. The AAL market is changing and is expected to boom in the next few years as a result of demographic developments and large investments by industries and stakeholders. Actual products, which have been on the market for several years, mainly consist of wearable systems and intelligent floor technologies; however their success is restricted to limited markets like nursing homes rather than the broader aged communities. In the context of independent living, wearable systems do not have the best acceptance for primary end-users (elderly), especially those who are not impaired.

The CARE fall detection system and services are integrated in the Everon caring system (Figures 1 and 2) for wider deployment in Europe, strengthening the independent living market and society.

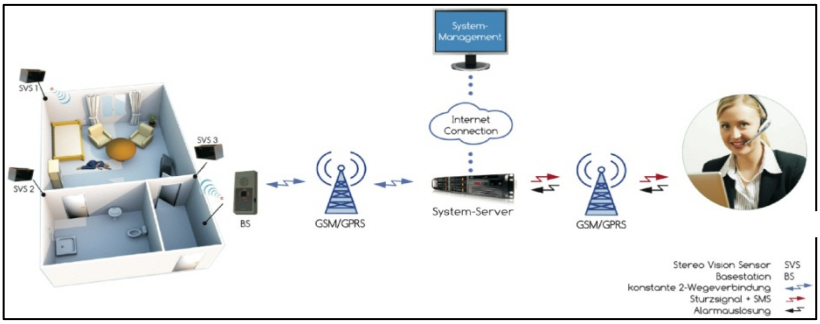

Figure 1: CARE system and service chain


Figure 2: CARE key technologies: Stereo vision system for fall detection (left), Everon wireless module (right)

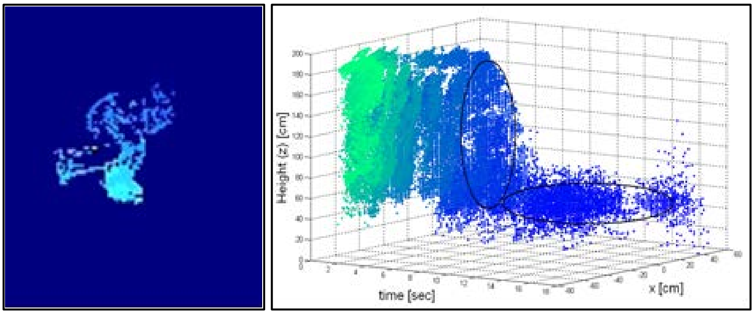

Figure 3. CARE data from the stereo sensor of a fall instant rendered in an image-like representation (left), spatiotemporal 4D representation of a person during a fall from a walking position (right).

PHONE-BASED FALL RISK PREDICTION

Vânia Guimarães[1], Pedro M. Teixeira[1], Miguel P. Monteiro[2], Dirk Elias[1]

Abstract

Falls are a major health risk that diminishes the quality of life among older people and increases the cost to health services. Reliable and earlier prediction of an increased fall risk is essential to improve its prevention. In this paper, we propose the use of mobile phones as a platform for developing a fall prediction system by running an inertial sensor-based fall prediction algorithm. Experimental results of the system, which we still consider as work in progress, are encouraging and could be of great value for older people and society.

1 Introduction

Falling is a serious and common problem facing an older person and frequently leads to injury, depression, loss of independence and reduced quality of life [1]. Besides external risk factors (e.g. slippery floor), medicament intake, chronic diseases and balance disorders also contribute to the occurrence of a fall [1]. Consequently, older people presenting some of these risk factors can be considered a high-risk target group. Multi-factorial interventions are applied to modify/eliminate the risks [2].

2 Risk prediction method

Given the multi-factorial nature of falls and the current problems of solution scalability, we propose a smartphone-based solution which comprises three main modules: the gait analysis test, clinic questionnaires and a feedback module, as illustrated in Figure 1. Several authors have found that gait speed lower than 70cm/s is associated with an increased risk [3]. In our first approach, the mobile phone was placed in the lower back of the trunk, attached to the belt. The gait velocity profile was obtained through acceleration data analysis read from an Android-based mobile phone [4]. Since the time stamps of all events were recorded, all gait phases (i.e. stance,

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swing, single and double support phases) could be properly delimited, from both a left and a right perspective.

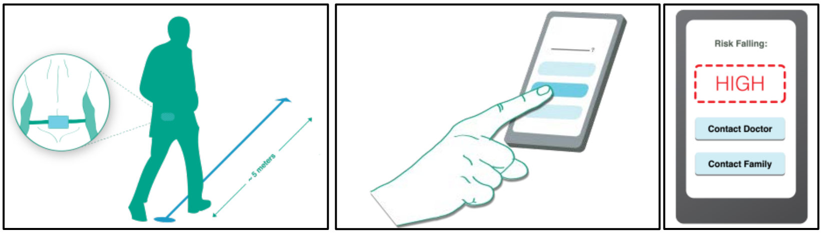

Figure 1. Proposed smartphone-based fall risk analysis solution

3 Results

A group of 14 participants (mean age 26±3.6, height 1.74±0.1cm and weight 73.5±11.3Kg) participated in the test. The experimental set-up comprised a walkway 5m long, with distance markers placed on the ground. Subjects were asked to walk along the walkway at three different self-selected speeds: comfortable normal pace, slower pace and faster pace. During each test, a simultaneous recording of a digital video camera parallel with the ground and of phone sensors was made.

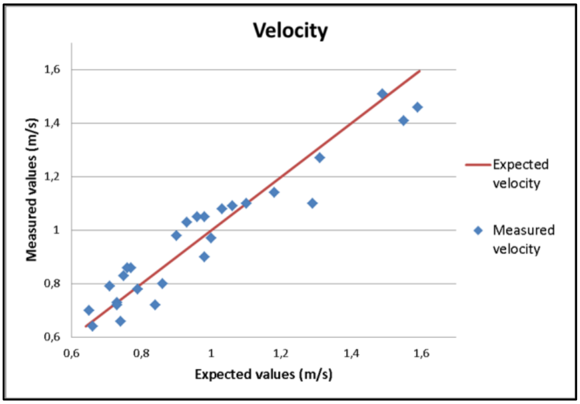

Figure 2. Expected vs. estimated velocity. Red line represents the expected velocity

The maximum velocity deviation from video-recorded values was 15%, and the mean deviation was 7±5%. A plot of the comparison between expected and estimated velocities is shown in Fig. 2.

4 Discussion

From the results, evidence exists that phone sensors signals can be used to quantify gait or other movements by extracting parameters related to the risk of falling. Other risk factors can also be assessed with the phone, by using the same questionnaires currently used by doctors at clinics. Evidence exists that in the future all these risk factors can be combined through the attribution of time-varying weights to each one, enabling the calculation of a global likelihood of falling. All the assessments can be made in an unsupervised manner and centralised on the phone, so that a complete history of risk factors can be compiled and transmitted to the doctor.

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PILOT PROJECT ON PHARMACEUTICAL HOME ASSISTANCE IN COMUNIDAD VALENCIANA

Paco Martorell, Maria Teresa Guardiola, Pilar Santamaría

Abstract

The Council of Europe defines dependence as the condition in which people find themselves dependent for reasons linked to the lack or loss of physical or intellectual autonomy. It causes a need for care or significant help so they can carry out their everyday activities. Although 99.8% of people from Valencia have a pharmacy close to home, there are at least 100,000 highly-dependent patients who cannot leave home or are bedridden.

Under the Pharmaceutical Home Assistance Programme the community pharmacist will provide a service, twice a month, in the patient's home, dispensing medication using the personalised dosage systems. S/he will also carry out a number of actions related to pharmaceutical care such as health checks, education and advice.

1. Introduction

With regard to the care of dependent patients, in 2001 the European Commission published a communication on 'The future of healthcare and care for the elderly: guaranteeing accessibility, quality and financial viability'.

Accessibility: The Court of Justice of the European Union has established case law stating that the proximity of pharmacies to patients is key to the application of policies that aim to achieve a high level of health protection.

Quality of life: No person should have to spend the last years of his/her life in an elderly people's home. The state should provide a minimum standard of healthcare services in the patient's home. According to experts, it is very important that a dependent person can talk about their needs, seek advice and receive treatment directly from his/her pharmacist.

Financial sustainability: It is stressed that in order to achieve better accessibility and capacity of healthcare without risk to their autonomy or dignity, patients should live at home. Priority should be given to home-based health care as opposed to assistance in nursing homes.

Spain has the Mediterranean Model of Pharmacy. It boasts the highest number of pharmacies and the best distribution across the territory, from the biggest city to the smallest village. Therefore, those who need more services such as the elderly, disabled and dependent have a pharmacy nearby which they can walk to as it is under 125 metres from their home.

There is a group of people, however, highly-dependent patients, who cannot walk to a pharmacy on their own and are at risk of losing direct contact with their pharmacist. In the Comunidad Valenciana (Valencia Region) the number of dependent people in grades I and III is far in excess of 100,000 and will increase as the number of citizens reaching 80 years old increases.

Dependent people in Grade II (levels 1 and 2) identified as having severe dependence require this assistance more than any other patients. They need help to do basic daily activities twice or three times per day but either they **do not want** permanent aid from a carer or they **do not need** extensive support for their personal autonomy.

Grade III people (levels I and II), highly-dependent patients, also require this assistance. They need help to carry out various activities during the day. Because of their significant loss of physical, mental and intellectual autonomy, these patients need the continuous and essential support of other people or continuous general support for their personal independence.

2. Methodology

The Conselleria de Sanidad (Valencian Health Department) and the three Official Associations of Pharmacists of the Valencian Region have developed a pharmaceutical care system that helps to fulfil these objectives. They have signed an agreement on domiciliary assistance.

The Pharmaceutical Home Assistance Programme includes services for users of l'Agència Valenciana de Salut (Valencian Health Agency) who count as highly-dependent patients whose special characteristics need personalised pharmaceutical care.

The Pharmaceutical Home Assistance Programme's multidisciplinary team decides which patient should be assisted at home by his/her usual pharmacists. Patients should accept their inclusion in the programme and agree to have their medication looked after, their domestic drug cabinet checked and the visit of a pharmacist to their home.

Accredited pharmacists will visit each patient assigned to the Pharmaceutical Home Assistance Programme linked to their pharmacy at least twice a month.

The dispensing of prescription medicines to the patient or carer will be done, when necessary, by means of a personalised dosage system (PDS). This system will be developed by the accredited pharmacists and will be given to either the patient or his/her relative/carer. They will also be given the information and documentation regarding correct dosage.

The pharmacist will carry out the following actions in the patient's home:

- identify inappropriate medication and reduce the intake of medicines;
- propose activities to improve adherence to therapeutic treatment;
- inform patients about the right use of medicines and how to use the devices to deliver doses;
- inform carers and relatives about the right use of medicines;
- revise the personalised dosage system (PDS) with a view to minimising medication before providing a new PDS that is more cost-effective and efficient;
- revise the domestic medicine cabinet with the patient or patient's relatives' consent;
- perform any other activity linked with the Pharmaceutical Home Assistance Programme and considered appropriate by mutual agreement between the parties.

3. Expected results

The pilot phase of the programme is expected to establish the best conditions for applying the Pharmaceutical Home Assistance Programme. It will define and measure clinical parameters and enable evaluation of the potential reduction of health and pharmaceutical expenditure as a result of the programme's implementation.

This pilot project will help to measure how happy patients and carers are with the system. Protocols for actions will also be established for national and international dissemination in all areas of health care.

ENABLING SOCIAL INTERACTION THROUGH EMBODIMENT (EXCITE)

Silvia Coradeschi[1], Amy Loutfi[1], Annica Kristoffersson[1], Amedeo Cesta[2], Gabriella Cortellessa[2], Lorenza Tiberio[2], Andrea Orlandini[2], Stephen von Rump[3], Javier Gonzalez[4]

Abstract

The ExCITE project advocates robotic telepresence for the elderly as a means to alleviate social isolation and to allow caregivers and relatives with little prior computer experience to virtually enter the home of an elderly person and conduct a natural, secure visit just as if they were physically there. Within the project, the existing robot prototype is deployed with the targeted end-users, and is refined by tightly coupling the users and designers in the development cycles of the prototype throughout the project. In this regard, a rigorous evaluation procedure is deployed in situ on a Pan-European scale and with a longitudinal perspective. Key project ideas are (a) user-centred product refinement, (b) user tests outside labs, in real contexts of use, (c) use over a period long enough to allow habituation and possible rejection to appear, (d) analysis of cultural and societal differences across European countries. A web portal for the project is located at http://www.excite-project.eu.

1. Social interaction via a teleoperated robot

The elderly of today have the clear ambition of staying independent and maintaining the same level of social interaction throughout their lives. The onset of age-related conditions is inevitable for the vast majority, however, and the decrease in both physical and mental health can impair mobility and contribute to feelings of isolation, loneliness and depression. For a generation with basic or moderate exposure to the internet and mobile phones, internet communication technologies (ICT) have the potential to play a significant role in maintaining contact with others. Yet, for this to be possible, it is critical that such technologies meet the requirements for successful interaction between individuals and fulfil both the need of the elderly to achieve suitable social interaction and the need of kin to be able to maintain contact.

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[3] Giraff AB
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Telepresence has long been advocated as a means to enable virtual face-to-face communications for people located in different places. A newer variant of telepresence that has recently emerged proposes to integrate ICT into robotic platforms and enable actuation in remote locations. The use of such systems as a tool to enhance social interaction for the elderly is still relatively novel. Used as a device to increase social interaction, however, robotic telepresence could be particularly suited to an elderly audience. In fact the elderly can interact with the robot in a natural and intuitive manner as little additional learning is required. In addition, the client connecting to the robot from a remote location gains a greater level of control by having the chance to move in the environment, which is clearly not possible in desktop applications. Despite this potential, the existing systems which advocate better social interaction have been subjected to little or no end-user validation with an elderly audience.

In the AAL project ExCITE we focus on evaluating user requirements for social interaction through robotic telepresence. The robotic system we use in the project is called Giraff and consists of a screen and web camera mounted on a simple robotic base that can be teleoperated. The figures above show examples of visits via the Giraff. In the first case, the Giraff is placed in the residence of an elderly person and the requirements of the system are assessed from the point of view of the person interacting with the device when embodied by a family member, spouse or healthcare professional and from the point of view of the person connecting to the device. In the second case, an occupational therapist communicates with an elderly person exercising at a day rehabilitation centre.

2. Evaluation and improvement of Giraff

Central to the project is the long-term evaluation of Giraff that will be achieved via long-term test sites. In the project 12 test sites will be maintained for one year. In the first phase of the project, we focused on providing the basic infrastructure for the test sites. A complete evaluation procedure, based on qualitative and quantitative analysis, has been designed for evaluating Giraff and its functionalities, considering different aspects of interaction with the users as well as the potential impact of Giraff on its users and their social interaction. The output of the user evaluation has been the basis of numerous technical, functional and aesthetic improvements. We have also started two test sites in each of the three involved countries (Italy, Spain and Sweden) and we are collecting user data for a thorough evaluation of the system. The figure above (figure 1) show two of the test sites. In addition we have collected immediate feedback from users (both end-users and clients) on Giraff, involving different types of potential client users such as formal caregivers like nurses and the operators of several organisations. The procedure used often entailed a practical session with the interested users. After the practical sessions, different alternative methods were used to gather feedback on the above-mentioned metrics: focus groups, interviews, and questionnaires. This evaluation has provided directives that can be used for quick improvements of the technology and to add functionalities to the system.

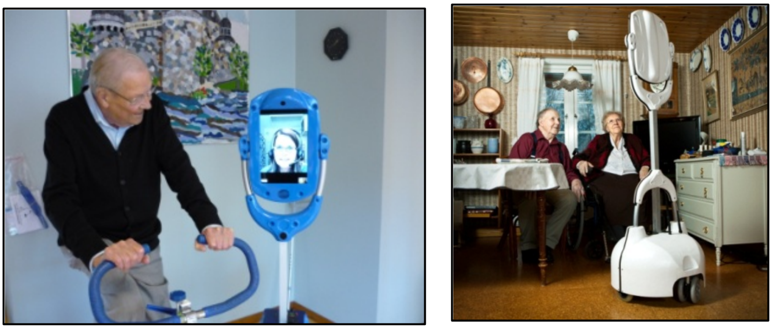

Figure 1. Test sites

Technical improvements of the actual platform and the pilot software have been implemented following the recommendations of the users and to overcome the technical difficulties encountered in long-term tests. They include the introduction of a database management system for users called Sentry and a remote control to initiate calls. Sentry allows care organisations to manage Giraffs and users within their own domain and enables the creation of Giraff identities, permissions between users and Giraffs and assignment of a callout user for each Giraff. This not only facilitates the working of the test site during the course of ExCITE, but is a long-term improvement that is part of the Giraff solution. The Sentry was a further response to a concern expressed by the elderly and caregivers, namely the need to be able to decide who is to have access to the Giraff and under what circumstances. A new remote controller was implemented that allows the elderly to call a pre-selected client user (callout user) but also to respond to or reject a call. The new remote is now under testing and will be further improved according to the feedback of the users. The physical appearance of the Giraff has also changed over time following user input. The latest version of the Giraff is shown above and a previous version is shown in figure 1.

More complex changes to the platform have also been implemented and focus on improvement in the mobility of Giraff. The implementation of semi-autonomous navigation for Giraff is ongoing. Furthermore, the map building task which aims to obtain a two-dimensional representation of the user's apartment is almost completed (figure 2). Software for producing a schematic map that is easier to use within the Giraff interface is on the agenda. The problem of recovering the Internet connection when the Giraff gets into areas with a poor Wi-Fi signal intensity has also been analysed.

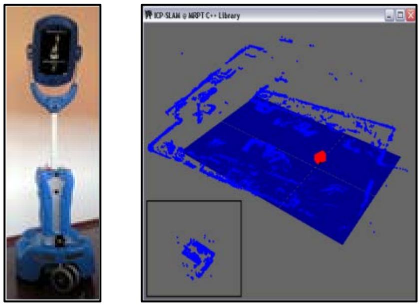

Figure 2. Representation of the user's apartment

From a commercialisation perspective, the main goal of the project over the next year is to initiate the first proactive marketing efforts for Giraff. These efforts will focus on the municipality, specifically on the social care organization, and we expect a dramatic reshaping of the current thinking on how Giraff should be sold. It is possible that it will ultimately not be a single product but rather a comprehensive service for social connection, integrating hardware, software, a 'crowd sourced' knowledge base and online user forums that bridge the gap between Giraff as an interesting technology and Giraff as a valuable solution for home care.

In the first year the groundwork has been laid for the cyclic evaluation and the first round of the cycle completed. The next two years will delimit the ExCITE project from other initiatives for prototype evaluation in that we will study in particular (1) the longitudinal effects of deploying the Giraff at the test sites and (2) the scalability of running in parallel a large number of test sites across Europe with a prototype that is still in a fairly early developmental phase. Many of the technical difficulties which arise from practical implementation of new technologies have been addressed in the first cycle. The following two years allow for a more in-depth study of many of the issues central to Ambient Assisted Living, such as how to engage the organisations in order to encourage the uptake of this solution and how the use of the new technologies changes over time and affects parameters such as loneliness and social isolation. We expect that the results obtained from the cyclic evaluations with Giraff will be partly generalisable to new technologies and offer insights into the process of deploying new technologies for independent living in the European market.

A YOUNG RESEARCHER'S WORKSHOP

YR-RISE RELOADED: RESEARCH ON INNOVATIVE SOLUTIONS FOR THE ELDERLY

Ilse Kryspin-Exner[1], Anna Felnhofer[1], Jasmine Gomm[1], Oswald D. Kothgassner[1], Doris Weber[1]

1. Introduction

This year's YR-RISE reloaded Workshop for Young Researchers and PhD students, which was generously sponsored by the Ambient Assisted Living Association (AALA), took place on Monday, 26th September 2011, in Lecce, Italy. Now organising the third edition of the YR-RISE Workshop we could draw on the experiences obtained in previous workshops and benefit from them.

The workshop lasted a whole day, including the teaser and poster presentations, discussions and a so-called "fantasy project" where participants were drawn together in groups to work on an imaginary project. Based on the experiences obtained at the AAL Forums in Vienna and Odense, discussions again were first conducted in the plenum, with the chairs leading each of the sessions, and were later on transferred to debates within each session group. This arrangement met with a great response among the young researches, as it provided them with plenty of time to introduce their ideas to their workshop colleagues and to discuss possible obstacles and challenges with both the expert chairs and among each other.

Below, the milestones of this year's YR-RISE reloaded Workshop shall be outlined and discussed in detail.

The first step in advertising the YR-RISE reloaded Workshop was to code and design a homepage with all the necessary information as well as the submission form (http://rise.univie.ac.at). Further steps included creating a call for presentations and advertising the workshop via email. This new web-based approach met with a great response, resulting in a large number of submissions.

2. Participants

This year's advertising and recruiting process for the YR-RISE reloaded Workshop was both enhanced and prolonged as opposed to last year's RISE Workshop in Odense

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2010. The amended procedure proved to be most effective in terms of reaching more potential participants and expanding our reach both in search engines and social networks. The first step was to design a new homepage, matching the specific topics of the YR-RISE reloaded Workshops with all the necessary information as well as the submission form (for more details see http://rise.univie.ac.at). A news section was created in order to keep potential participants informed about the progress of the submission review process and keep them updated about upcoming deadlines and events. Further steps included creating an official call for presentations, which was sent to previously selected institutions (such as companies, universities and research institutes) via e-mail. Specific information and links to the homepage were posted on selected social network sites (such as Facebook) and research related topics. Additionally, an invitation letter was sent to former participants of the workshop, inviting them to rejoin the workshop and present the progress of their work to new colleagues.

Altogether, this new web-based approach met with a great response resulting in a large number of submissions. After a detailed review process conducted by the Viennese team, the best 29 participants and their projects were selected to be presented at the YR-RISE reloaded Workshop in Lecce (for a detailed overview regarding the participants and the topics presented see the table below). The participants were assigned to four sessions, each embracing a different topic related to AAL research. E-mails were sent to each submitting party informing him or her about the result of the review process and highlighting upcoming deadlines (such as submission of PowerPoint-teaser-presentations and menu selections for the get-together).

ICT and Robotics for Health	
A. Grguric, S. Desic & M. Mosmondor	Towards medication management in smart homes
M. Donati, T. Bacchillone, L. Fanucci & S. Saponara	A flexible home gateway system for telecare of patients affected by chronic heart failure
C. Suárez-Mejías, A. B. N. Saucedo, P. B. G. De Castro, C. E. R. De Vargas, C. L. P. Calderón & S. L. Gonzalez	Robotic assistant and innovation technologies for motor rehabilitation
L. Tiberio	Assessing safety and tolerability of a telepresence robot for frail elderly
P. Raspa	A mobile platform for human tracking and interaction using a RGB-D camera
E. Torta, R. H. Cuijpers & J. F. Juola	A cognitive robotics architecture for Ambient Assisted Living: The experience of KSERA project
R. Planinc	FEARLESS – A computer vision system to detect falls

Social Networking and Social Inclusion	
M. Conci	Understanding older adults' attitude towards online social networks
J. Roo, **E. Hage**, M. van Offenbeek & A. Boonstra	How may ICT enhance quality of life in rural areas?
N. Hauk, A. Felnhofer, O. D. Kothgassner, E. Kastenhofer & I. Kryspin-Exner	Closing the gap
K. Neureiter	Supporting social connectedness for elderly people
C. Lagoda	Development of a rehabilitation support platform
P. Jordan, P. A. Silva & **R. M.G. de Oliveira**	mobileWAY: Analysis, design and development of an interactive system to support early stage dementia patients and their families
N. Röll	End-user integration for the development of Ambient Assisted Living systems

Assistive Technologies	
A. Andrushevich, R. Kistler & A. Klapproth	Building intelligence as enabler for ambient assistance applications
V. Fuchsberger	Media literacy as key to acceptance and adoption of assistive technology?
M. Donati, L. Fanucci & D. Mandoloni	e(asy)Phone: A simpler approach to mobile phone
S. Spinsante, E. Gambi & L. Polidori	Video based movement analysis for automated "Get Up And Go" test
G. Yin & D. Bruckner	Sensor fusion for Ambient Assisted Living

Virtual Simulations, Interfaces and Serious Games	
F. Schaetzlein	Evaluation of natural interaction of senior citizens in a virtual reality
G. Diraco, A. Leone & P. Siciliano	Towards to analysis of ADLs with 3D TOF vision: A preliminary study.
E. Kastenhofer, O. D. Kothgassner, N. Hauk & B. U. Stetina	Vital vs. virtual: Probing cardiovascular and affective reactivity of vital and virtual stimuli
A. F. F. Vasconcelos, P. A. Silva & F. Nunes	Analysis, design and evaluation of a tablet-based gaming platform for older adults

T. Marques, P. A. Silva & **F. Nunes**	Development platform for elderly-oriented tabletop games
A. Aranbarri, J. Murgoitio, M. Larburu & A. Urquiza	Assistance for the elderly through a multimodal HMI connecting home and car scenarios
K. Gitau & **F. Ferracuti**	Cubature Kalman filtering of EEG-based brain-computer interfaces

Concordant with last year's success, this year's YR-RISE reloaded Workshop again determined three so-called winners among the participants of the workshop. The young researchers were asked to name three colleagues with the best oral teaser presentations and the most convincing poster presentations. Following a secret selection, three winners were chosen among the participants: Katja Neureiter (Austria, ICT&S Center Salzburg) with the project *Supporting social connectedness for elderly people* came third, Kareithi Gitau and Francesco Ferracuti (Italy, Polytechnic University of Marche) with their project *Cubature Kalmam filtering of EEG-based brain-computer interfaces* finished second, and Elena Torta from the Netherlands representing the Eindhoven University of Technology (project: *A cognitive robotics architecture for Ambient Assisted Living: The experience of KSERA project*.) came first. The winners were rewarded with typical Viennese chocolates from Manner© as well as small rewards from the AAL Forum, which were sent to them after the end of the overall AAL Forum 2011.

3. Procedure

After a detailed review process the best 29 projects were selected to present at the YR-RISE reloaded Workshop in Lecce. The participants were assigned to four sessions, each of which was supervised by a senior researcher:

- Session 1: *ICT and Robotics for Health* was chaired by Birgit Stetina (Faculty of Psychology, Webster University, Vienna),
- Session 2: *Social Networking and Social Inclusion* was supervised by Ilse Kryspin-Exner (Faculty of Psychology, University of Vienna) and co-chaired by Oswald D. Kothgassner (Faculty of Psychology, University of Vienna),
- Session 3: *Assistive Technologies* was supervised by Ilse Kryspin-Exner (Faculty of Psychology, University of Vienna) and co-chaired by Anna Felnhofer (Faculty of Psychology, University of Vienna) and
- Session 4: *Virtual Simulations, Interfaces and Serious Games* was guided by Helmut Hlavacs (Working Group Entertainment Computing, University of Vienna).

Similarly to the previous years, prior to the start of the workshop on Sunday, 25th of September, participants were invited to a get-together, which was held in a typical Italian bar in the centre of Lecce and offered an Italian menu to all the guests. The main idea of this event was to familiarise the participants with each other's faces and hence establish a nice atmosphere for the next day's workshop. As usual, this event met with great response: almost all of the 29 participants of the workshop participated in the event and thus became acquainted with each other and started discussing and networking right away, keeping it up all evening and throughout the workshop.

The workshop started with an introduction to its procedures, topics and the overall aims, and continued with the short teaser presentations from each participant, which were arranged within the four sessions and guided by each chair but presented to all participants. Those teaser presentations consisted of no more than three slides to only provide the auditorium with a brief insight into the ongoing project, its scope and endeavours. This was meant to relate the interactions between the four sessions and to enhance the exchange of ideas regarding projects differing in content and use of methodology. After each presentation the auditorium was allowed to ask some questions. Following the teaser presentations and short discussions, the participants were assigned to their sessions. Within the sessions each participant presented his or her poster and thus provided a more detailed insight into the project, which allowed further discussion about each project in the session groups. Various questions and lively debates marked this phase of the workshop, and it was here that an apparent wish for a theoretical exchange upon methodological aspects of each project became evident among the participants. The poster session allowed participants to freely choose and discuss the projects they were most interested in. The final activity of the workshop agenda was the “fantasy project”.

Below, each session shall be discussed in more detail to provide an insight into the activities of the YR-RISE reloaded Workshop.

Session 1: ICT and Robotics for Health

This session was chaired by Birgit Stetina and focused on the field of robotics, and especially the embedding of robots in the home environment for enhancing the quality of life of the elderly. Projects presented clearly provided evidence of the different prospects of including a robot into the home environment, ranging from Ursus, a robot in a bearskin who surveys and if necessary adjusts physical exercises in combination with the nowadays well-known Kinect™, to human-like robots which are designed to interact with the elderly to alleviate social exclusion. Another robot was designed like a giraffe with a screen on the top of the “head” which is able to move around the house connecting frail older people with their relatives and friends.

Some presentations rather stressed the structural and technological background of developing the robots and communication technologies, while others clearly focused on the end users. Aspects of acceptance and usability were discussed with a focus on the ease of use to ensure that older people were capable of using the system.

Like the previous years, the interdisciplinary discourse, which marks the developmental phase of a technological innovation, was an important issue and many young researchers reported misinterpretations and misapprehensions when communicating with stakeholders or professionals originating from other disciplines than their own. While the debate around this subject was progressing, it became all the more clear that this workshop contributed a great deal to ameliorating this multi- and interdisciplinary communication, as it provided a unique platform to exchange very diverse ideas and approaches.

Session 2: Social Networking and Social Inclusion

This session was chaired by Ilse Kryspin-Exner and co-chaired by Oswald D. Kothgassner; and participants were led through a wide range of projects affecting social inclusion and the contemporary issue of social networking through the technology of older adults. In particular, older people with impairments and limited physical mobility would greatly benefit from accessing social network services and gain social support through the implementation of social technology. The usage of ICT solutions should foster social connectedness among older adults who are restricted in mobility, by gaining access to applications for active ageing, communicate and share interests with younger generations or peers to enhance well-being and their quality of life. However other modulating context effects – like skills, local ties, gender and usability – between technology-based social networking and quality of life should be further investigated.

Discussing the problems of users' acceptance and the usability of technology-based social networking systems led to questions about the integration and inclusion of end-users for the development of assistive solutions. These concerns seem to be an important issue in improving the usability and the acceptance of those systems. Testing usability and the definition of end-user's needs is often done by the developers themselves instead of including end-users. Alongside this issue is a lack of senior-suited instruction manuals for technology solutions, guiding users through the application and helping the older person understand the benefits and risks through distinct and appropriate information.

Beside the importance of meeting the older adults' needs and interests in research and the development of prototypical systems, the integration of results from basic research is greatly required in this field. This urges all professionals engaged in these purposes, but should not be limited to them. Nevertheless, following a further mutual exchange it was agreed that consistent nomenclature and evident theoretical approaches are necessary for further research and evaluation. This should be stated as a significant step and a future direction for the AAL roadmap.

Session 3: Assistive Technologies

The session "Assistive Technologies", which was chaired by Prof. Kryspin-Exner and co-chaired by Anna Felnhofer, focused primarily on AAL-related technological devices, their field of application, their scope and impact on the target group. The related technological devices presented by the young researchers were quite heterogeneous, ranging from smart home systems, mobile phone applications, movement analysis devices and complex sensory systems. Despite the projects' heterogeneity, they were invariably targeted at enhancing both the independence and overall quality of life of elderly people. Furthermore, they proved to be very considerate of end-user specific questions regarding usability, acceptance, security aspects and perceived ease of use, despite the fact that all project were still in a developmental phase and far from being offered to potential end-users. Hence, the discussion accompanying both the teaser-session and poster presentations predominantly focused on psychological and ethical issues especially relevant to the trial phase of technology-based studies.

At various stages of the lively debates among the young researchers and the auditorium the following essential questions were considered: How can a large sample of end users for methodologically sound studies be obtained? What kind of research setting is reasonable for vulnerable populations such as elderly people? How can age-specific needs and wishes be reliably identified? Is there any proof of older adults' non-acceptance of cameras in their private environment? Does this acceptance or non-acceptance have to be evaluated each time a project includes this kind of technology? What kind of theoretical models have proven to be valid pertaining to technology-acceptance research?

All the above mentioned questions were discussed among the session members during both the teaser presentations and – more deeply and thoroughly – the poster session, yet most of them had to be left for further mutual exchanges among the workshop's young researchers and other colleagues and experts as well as senior researchers.

Session 4: Virtual Simulations, Interfaces and Serious Games

This session was chaired by Helmut Hlavacs and focused on the field of virtual simulations, interfaces and serious games. Virtual realities as well as serious games are growing fields pertaining to various disciplines. Playing games is already part of the routine of many elderly peopple. Nevertheless, the gaming industry is still solely targeting younger players.

Basic research has been done according to the field of virtual reality treatments, when the effects of a virtual dog avatar and a living dog on cardiac autonomic modulation were examined with comparable results. Another approach for treatment was conducted with a framework that enables the creation of several table-top games. This framework provides a set of tools that facilitates game development for table-top systems, enabling developers to build more suitable games to stimulate older adults. The aim of these games is to treat age-related changes in cognitive and motor abilities, while people were entertained and interacted with other players fostering social networks.

Focussing on virtual interface usability and naturalistic mapping using a virtual hand instead of a common cursor type was urged to satisfy users' needs to interact with the simulated environment. The development of assistive Brain-Computer-Interfaces for older and paralysed individuals enables an alternative way of communicating with their environment. The interface infers the users' intents from recorded electroencephalogram signals; this allows the control of external devices by imagined movements. A future progress could extend this interface type to many assistive technologies.

Discussion in this session also revolved around the needs of older adults and their acceptance, which have to be considered when designing games or interfaces for the elderly. Again, the importance of the simplicity of the systems was approached as well as end-user involvement in the design-process of games for older adults.

Fantasy Project

For the workshop's final special task, the "Fantasy Project", participants were randomly assigned to four different groups, each working on one of the four topics, (1) enhancing social life, (2) enhancing a healthy lifestyle (active ageing), (3) preventing risky behaviour/critical situations, and (4) enhancing compliance (mediaction). The four groups were asked to create a short outline of a (preferably empirical) project pertaining to this topic. The scope of this task was to bring different disciplines together and engage them in a dialogue on an exemplary project. The results of the short within-group discussions are presented below:

1. **Enhancing social life**
Participants working on the enhancement of the social life of the elderly raised questions about how new technologies could enhance the social life of older people and motivate them to go outside. The idea was to develop an online platform similar to Facebook for the elderly who are not afraid of technology. To foster going outside and keeping them up to date, an event organiser should be integrated which also suggests events based on the interests of the person.

2. **Enhancing healthy lifestyle (active ageing)**
The current situation of older people in society was analysed and it was concluded that older people have to find their role in society so that they do not feel useless. Important aspects of active aging (e.g. cognition, physical or social activities) could be enhanced through the use of technology, whereas the most important aspect for the continued use of technologies in old age for active aging seems to be the fun factor.

3. **Preventing risky behaviour/critical situations**
The first step was to define and determine risky behaviours or critical situations, and afterwards participants tried to find solutions for their prevention. The output of this group was a smart home or mobile device which educates or provides reminders to the older person, e.g. for taking their medication or turning off the oven, and later on also triggers further steps to alleviate critical situations by itself.

4. **Enhancing compliance (medication)**
Participants of this group discussed some kind of video version of Wikipedia for informing older people about topics related to compliance and medication. Also, ideas about positive cues related to the intake of medication, like playing nice music or including relatives, in order to enhance compliance were discussed.

4. Conclusion & Forecast

In summary, this year's YR-RISE reloaded Workshop again provided a unique platform for young researchers from diverse disciplines and countries to take part in a professional multidisciplinary exchange upon AAL solutions for elderly people, and to furthermore engage in a wider discourse beyond the framework of the workshop with other AAL Forum participants. As we could observe, the young researchers were overly grateful for the possibility to share their ideas amongst their peers and to get feedback from senior researchers and experts in their field of study. Furthermore, the young researchers confirmed the importance of such an event for their own progress as well as for external communication among researchers and stakeholders. The only regret that was brought to our attention pertained to the time estimated for the workshop: repeatedly our workshop's participants pointed out that prolonging the workshop's time from one to two days would have had an positive impact on the quality of the group discussions, enabling even more thorough debates. Altogether, the repeated success of this event clearly points towards the need to foster further events to allow a broad, multidisciplinary debate to take place within Europe and beyond.

AAL OPEN ASSOCIATION: EVAAL COMPETITION

1ST EVAAL COMPETITION: INDOOR LOCALISATION AND TRACKING FOR AAL

Juan-Pablo Lázaro-Ramos[1], Angel Martinez[1], Dario Salvi[2], Alejandro Medrano Gil[2], Alvaro Fides[3], Pilar Sala[3]

Abstract

EvAAL (Evaluating AAL Systems Through Competitive Benchmarking) is a new initiative aimed at evaluating solutions related to Ambient Assisted Living by organising annual international contests, with specific topics in the context of the AAL Forum. It aims at raising interest in the research and developer communities in the multidisciplinary research fields enabling Ambient Assisted Living, and at creating benchmarks for the evaluation and comparison of AAL systems. In particular, EvAAL will not only focus on comparison of algorithms, but also of cost, deployment effort, and time. The topic of the first EvAAL competition was on Indoor Localisation and Tracking for AAL. It took place with 6 competitors from the 25th to 29th of July 2011 in Valencia, Spain. The competitors had to pass an admission process based on a review of submitted papers. In this session, the competitors presented their solutions followed by the report from the program committee on the process and results of the contest. This paper describes the organisation aspects of this first EvAAL competition.

1. Introduction

EvAAL (Evaluating AAL Systems Through Competitive Benchmarking) is an international competition aimed at growing the AAL community and spreading the universAAL platform within this community. The main technical objectives of the competitions organised by EvAAL are to:

- Enable the comparison of different Ambient Assisted Living (AAL) solutions
- Experiment with benchmarking and evaluation methods
- Identify relevant AAL problems, requirements and issues
- Identification of new, original solutions for AAL

With this aim EvAAL was inspired by successful competitions such as the Trading Agent Competition [1] (TAC) and the DARPA Grand Challenge [2].

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The EvAAL competition has been organised by focusing on specific technological challenges related to AAL, and will use the results achieved from the competitions on these subjects to develop a set of tools and methodologies, with a view to approaching the complete problem in a subsequent phase. Consequently, some of the possible competitions that are considered in the initial phase of EvAAL could be: sensing (this theme covers the aspects of collecting any kind of contextual information from the environment), seasoning (concerned with the problem of transforming contextual data into knowledge), acting (concerning environmental control through actuators), communication, interaction (among usera and the AAL system), etc.

EvAAL is an initiative proposed by the universAAL FP7 project (http://www.universaal.org) and promoted by the AALOA community (http://www.aaloa.org).

The first EvAAL competition was focused on the special theme of indoor localisation and tracking. The main objective of this competition as organised by EvAAL is to enable the comparison of different localisation solutions, by establishing suitable benchmarks and evaluation metrics.

Localisation is a key component for achieving context-awareness. In most cases, however, location information is limited by accessibility to Global Navigation Satellite Systems (GNSS), largely unavailable for indoor environments. The scope of this competition is to award the best indoor localisation system from the point of view of Ambient Assisted Living (AAL) applications. This competition was an opportunity to bring together both academic and industrial research communities to work together on localisation and tracking for AAL, to evaluate various approaches, and to envision new research opportunities.

For organisational and technical reasons, EvAAL 2011 was organised in two major events: the actual competition was held at the CIAmI Living Lab in Valencia (Spain) on the 27th–29th July, and the concluding workshop was held in Lecce (Italy) on the 26th of September (the workshop was a side event of the AAL Forum (http://www.aalforum.eu)).

2. Call for Competition

The Steering Board appointed Stefano Chessa (ISTI-CNR, Italy) and Sergio Guillem (ITACA-UPV University of Valencia, Spain) as the General co-Chairs of EvAAL 2011, and established the Organisation Committee (responsible for the logistical issues of the whole competition) and the Technical Program Committee (TPC), which was the scientific committee for the (only) track on indoor localisation and tracking.

The TPC was composed of experts in the field of localisation and tracking, from six different countries. Six out of thirteen members were from outside the universAAL project. Candidate competitors, through a call for the competition (available at http://evaal.aaloa.org), were invited to submit a paper describing their localisation system: hardware, deployment, and the algorithms and protocols used. A "competitor" could be any individual or group of individuals, from one or several organisations, working as a single team. The applicants to the Call for Competition submitted a paper to the TPC describing their system. The TPC received 10 applications from 7 different countries. The papers underwent a peer review by the TPC members. Nine papers were accepted; six accepted, three with major revisions and only one rejected. Two competitors could not participate due to hardware problems and for commercial and internal issues, and one competitor was finally admitted as a guest.

The other seven competitors were invited to participate in the competition itself, which was held at the CIAMI Living Lab (http://www.ciami.es) in Valencia, during the last week of July 2011: n-Core Polaris, iLoc, SNTUmicro, GEDES-UGR, AIT, and OwIPS. Table 1 shows the name of the teams and their nationalities.

Table 1. Team nationalities

Team Name	Nationality
n-Core Polaris	*Spain*
iLoc	*Germany, Switzerland*
SNTUmicro	*Ukraine*
GEDES-UGR	*Spain*
AIT	*Austria*
OwIPS	*France*

3. Location of the competition: CIAMI Living Lab Valencia

The competition took place at the CIAmI Living Lab (http://www.ciami.es). It is an approximately 90 m^2 infrastructure that simulates the real environment of an individuals' home (a map of the lab is shown in Figure 1). Requirements of the Living Lab in order to host the competition were: a place that simulates a house; with rooms; removable ceiling/floor; ethernet, Wi-Fi, clean RF-environment (no interference); easy to attach devices; continuous video recording system; availability of supporting team of people; availability of side meeting rooms; screen to show paths in real time; possibility to hide human paths (painted on the floor), etc.

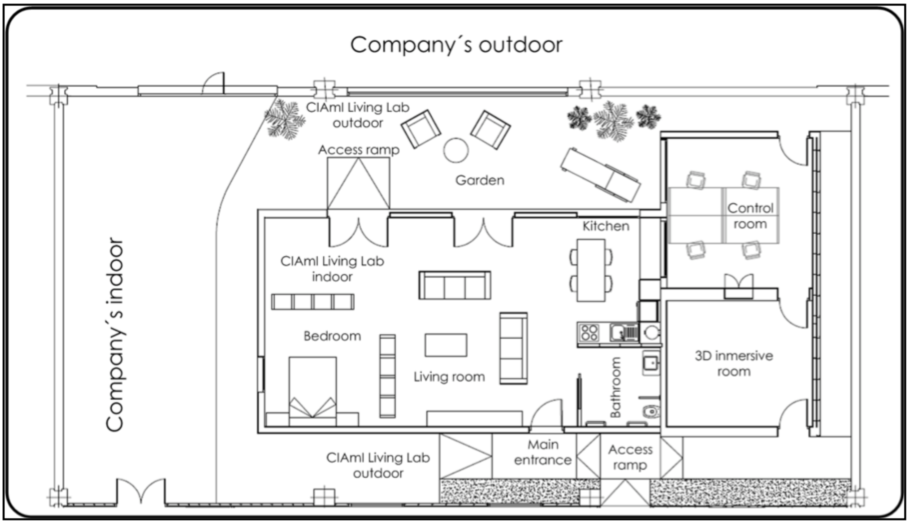

Figure 1. Map of the CIAmI Living Lab

When preparing the competition, the EvAAL Committee identified the need for having a reference localisation system that was considered as a reference to compare with the competitors. The idea was that this system would be able to detect precisely where the user was at each moment.

Therefore a research process started with the aim to find a system that was precise enough (less than 0.5 metres), made no interference, was easy to install and deploy and had an interface to communicate with/from. However, there was also the requirement to have a reference system that was technologically neutral, in order to be fair to all competitors and their respective technologies. For these reasons the organisers defined a reference localisation system based on the idea that one person could perform certain walking patterns that could be repeated for every competitor, so it is conducted at the same speed and for the same amount of time for any competitor. Apart from the low cost of this solution compared to the installation of a complete localisation system, the rules of the competition defined that one system obtains the maximum points for accuracy if the error of the competitor's localisation calculation and the real one is less than 0.5 metres (a picture of the preparatory work of the reference localisation system is shown in Figure 2).

In the end, the reference localisation system is based on the following rules:

- The CIAmI Living Lab´s floor is covered with marks that show where the actor has to step. Each mark simulates a single footprint (alternate right foot and left foot). At least 3 paths were defined and the competitor needed to localise the human moving by following those paths.
- The entire CIAmI Living Lab´s floor was covered by a plastic surface with the routes to be evaluated attached to it (non removable format) to prevent competitors from fine adjustments. Routes are unknown by the competitors.

A fourth route was created to conduct a second localisation test for detecting when the user was at an areas of interest.

- Each step is synchronised with an easy timer application (a digital metronome like the one used by musicians to follow a constant rhythm). It is composed by two audio signals: a countdown as a prelude to help the human actor synchronise and a periodic clock beep that indicates the right cadence (one beep, one step). Paths always start with the left foot.

Each competitor was asked to produce an interface with a software system based on the universAAL platform, the mission of which was to collect samples every half a second and record them for the calculation of availability and accuracy evaluation criteria.

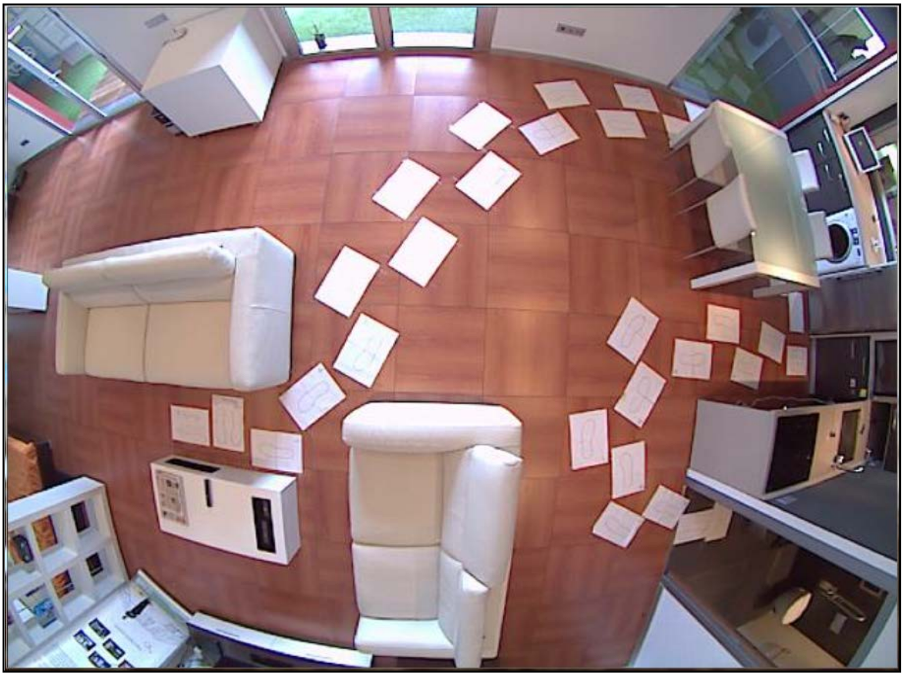

Figure 2. Preparation of the reference localisation system at the CIAmI

4. Financing

Most of the logistics costs were covered by the CIAmI living lab, while some partners of the universAAL project contributed with work force, part of the logistics and benchmark preparation costs (including gadgets given to the competitors and the plates given to the winners), and the costs of the EvAAL workshop.

The EvAAL competition 2011 was not a public event, in fact the competitors deployed their systems separately and the evaluation of each system was done independently. The results obtained (datasets, description of the systems used by the competitors, benchmarks, toolkit development, etc.) however should be public. For this reason we published all the output results in a dedicated workshop where the competitors were invited to describe their systems. The workshop was organised as a side event of the AAL Forum (http://www.aalforum.eu), which took place in Lecce (IT). The AAL forum is an annual conference of the Ambient Assisted Living Joint Programme. The objective of the AAL Forum is twofold: on the one hand the conference aims to show the significant progresses made by the AALJP projects and its practical implications on the daily life of seniors. On the other hand considerable attention will be dedicated to the most recent EU initiatives, like the pilot European Innovation Partnership on Active and Healthy Ageing.

The AAL Forum provided logistic facilities, publicity and dissemination and publication of the workshop proceedings. The cost of the prizes for the winners (plates and smartpens) was covered by some of the partners of the universAAL project, which also, additionally, partially covered the competitor's costs by reimbursing their expenses for participating in the AAL forum up to a maximum of 800€. Competitors bore their own expenses for participating in the competition in Valencia (Spain).

5. Conclusions and ideas for the future

The first edition of EvAAL involved the participation of a large number of teams, representative of many EU countries. The objective of EvAAL is to grow more and more by involving more people in its organisation and in the competing teams, in order to become a reference event for AAL in Europe. For this purpose a Call for Ideas has been opened (available at http://evaal.aaloa.org) to which any AAL stakeholder can apply to provide ideas for new competitions and improvements to already established competitions.

For further reading about the evaluation criteria, results and scientific conclusions from the EvAAL Competition please read "Evaluating AAL Systems Through Competitive Benchmarking (EvAAL) – Technical Aspects of the First Competition" present in the current publication of the proceedings.

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PRECISION INDOOR OBJECTS POSITIONING BASED ON PHASE MEASUREMENTS OF MICROWAVE SIGNALS

Igor Shirokov[1]

Abstract

The phase method of object positioning is considered in the paper. The distances are measured in terms of microwave phase difference or in parts of wavelength. The homodyne method was put on a basis of microwave phase difference measurements. The beacons are placed in a room and they radiate microwave signals. The transponders are placed on the objects, or are wearable by the elderly/disabled who are to be located. The transponders shift the frequencies of microwave signals and reradiate the frequency-transformed microwave signals back in the direction of the beacons. Each beacon selects the low-frequency difference signals, and measures the phase differences between these signals and the reference one. Based on these measurements the distances to the transponders are calculated.

1. Introduction

Microwave propagation offers a good opportunity for object positioning. The use of the pulse radar method for measuring distances and angles are quite unsuitable for indoor applications. The resolution of this method is too low and there is a minimal distance requirement of the pulse radar measurement that is usually higher than the size of the room. The resolution of the phase method of distance measurements is determined by the microwave length. Depending on the wavelength one can obtain an accuracy of 10 mm and more [1]. In this paper, a new method of people positioning is presented. Positioning is calculated in terms of distance measurements, from the beacons to transponders that are wearable by the elderly/disabled. The microwave phase progression measurements are used for these purposes. No doubt the phase method creates an ambiguity, because the phase measurements can only have values in an interval between 0–2π. In this paper a method of bypassing this problem is discussed.

The task of the simultaneous positioning of several objects is often needed; particularly in the issue of tracking the movement of several elderly people in a living

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room and neighbouring areas. The number of assisted people can reach several tens within the profile of the entire institution, and all of them can visit certain rooms. In this case the problem of object differentiation arises. Furthermore, the electromagnetic compatibility (EMC) of the functioning of several radio engineering units must be taken into account. The simultaneous functioning of these units must not deteriorate the object's differentiation and its positioning. A way of solving this problem is discussed in the paper. Further, people tracking assumes the radiation of electromagnetic waves. Certainly this radiation should not affect human health. The system's radiating power must be as small as possible in this case. The radiation of electromagnetic energy from wearable devices also preferably has to be excluded. This issue is also discussed in the paper. Besides the above-mentioned technical and healthcare aspects, the system had to be efficient from an economic point of view. All of the system's units must be of the simplest design. The hardware installation must not involve essential manpower. The system's power consumption must be as small as possible. In other words, the system must satisfy the demands of state-of-art tendencies of so called "green communication". These aspects are discussed in the paper.

2. Approach to a Problem

The system implementation, which is free from the problems mentioned, assumes the use of a homodyne method of microwave phase measurement, which has been well developed in the author's previous works [2, 3, 4, 5, 6]. The further development of this approach takes place in the paper. Realizing the homodyne method of microwave phase measurement and, consequently, distance determination within a room, we propose placing the radio beacons along the extended wall and at a certain distance from each other. The positioning of objects is characterised by the distance from the objects to each beacon.

The number of beacons can be higher than 2 and they can be placed along different room walls. This ensures the elimination of doubt in the distance determination, and additionally it ensures that the system functions over the entire room square, at arbitrary distances from the beacon(s) to the object(s). But these aspects are not discussed in the paper, and elimination of doubt is solved through organisation. Certainly, the system only operates in a room. Usually the material of the wall is not at all transparent for microwaves (we do not consider wooden walls), or signals are greatly damped. In this case additional beacons must be installed in the neighbouring room. We do not want to "lose" a person on entering the next room. He will be "visible" for beacons of both rooms when walking through a door aperture.

The transponders are placed on the objects (elderly/disabled) that are to be located. The number of objects can be arbitrary, but with certain restrictions which will be discussed later. In the paper we will discuss the simultaneous operation of two transponders, not changing the approach to a problem in general.

Taking into account the system base and all distances, we can easily determine the object's positions in a Cartesian coordinate system with respect to the system base and beacons.

The block diagrams of each transponder and each beacon are shown in Figure 1.

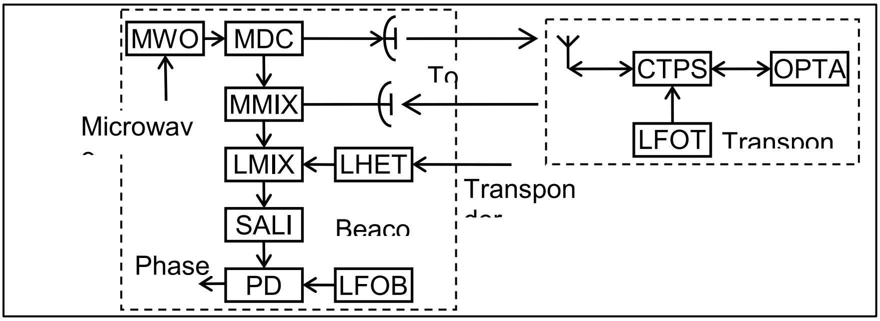

Figure 1. Block diagram of the beacon and transponder

Each transponder, which is placed on the object, consists of a microwave antenna, controlled transmission phase shifter (CTPS), one-port microwave transistor amplifier (OPTA), and low-frequency oscillator of transponder (LFOT). Each beacon consists of a microwave oscillator (MWO), microwave directional coupler (MDC) microwave transmitting antenna, microwave receiving antenna, microwave mixer (MMIX), low-frequency mixer (LMIX), low-frequency heterodyne (LHET), selective amplifier-limiter (SALIM), low-frequency oscillator of beacon (LFOB), and phase detector (PD). The "Microwave Frequencies" line assumes control of the microwave oscillator frequencies. The frequency changing is of need for adequate distance determination. The frequencies of different beacons must be different but closely spaced. The problems in choosing the frequency will be discussed later. The phase differences of low-frequency signals are obtained on the "Phase Differences" line. These phase differences of low-frequency signals contain information representing the phase progression of the microwave signals. The "Transponder Selection" line assumes frequency control of a low-frequency heterodyne. Fig. 1 represents the serial treatment of transponder signals. Obviously, the use of parallel chains after the microwave mixer assumes parallel signal treatment. In this case the processing time will be lower, but the hardware cost will be higher.

3. Base Equations

Each i^{th} beacon radiates the microwave signal that can be described as $u_{i1}(t) = U_{i0}\sin\left[\omega_{i0}t + j_{i0}\right]$, where U_{i0} is the amplitude, ω_{i0} is the frequency, and φ_{i0} is the initial phase. These oscillations are radiated in the direction of the inner part of the room where the j^{th} object is placed. The microwave, propagated over distance d_{ij}

, obtains the attenuation A_{ij} and phase progression $k_{i0}d_{ij}$: $u_{ij2}(t) = A_{ij}U_{i0}\sin\left[\omega_{i0}t + k_{i0}d_{ij} + j_{i0}\right]$, where $k_{i0} = 2\pi/\lambda_{i0}$ is the propagation constant, and λ_{i0} is the wavelength. The j^{th} transponder receives this microwave signal via its microwave antenna. Then the controlled transmission phase shifter implements the monotonous change in microwave-signal phase over period T_j of the low-frequency oscillations by the value π. The block diagram shown assumes the passing of the microwave signal through the phase shifter twice. So, the microwave-signal phase will be changed by the value 2π over the period T_j of the low-frequency oscillations. The change in microwave-signal phase over period T_j of the low-frequency oscillations by the value 2π is tantamount to the frequency shift [7] of a microwave signal over the frequency $\Omega_j = 2\pi / T_j$. In a certain assumption, this technical solution is equivalent to the Doppler's frequency shift. The amount of frequency shift is chosen to be small. In reality, F_j ($F_j = \Omega_j / 2\pi$) is equal to tens of kilohertz or close to it, and in any case it does not exceed the value 100 kHz. One more feature is observed in this case: the initial phase of the controlling low-frequency oscillations φ_{jL} is directly transferred into the microwave-signal phase, without any changes. This feature was utilised on the basis of the author's previous investigations [2, 3, 4, 5, 6]. After the controlled phase shifter the microwave signal is amplified by the one-port microwave transistor amplifier [8].This microwave amplifier possesses the highest simplicity of design implementation, has very low power consumption, and has excellent noise characteristics. The described amplifier operates within a narrow frequency band, but this feature is not significant in our case. Furthermore, perfect antenna matching can also be implemented over a narrow frequency band. Thus, we obtain the microwave signal amplifying in 20–30 dB with the noise factor $N_F = 0.3$ dB at 1.5 GHz. Further, the amplified microwave signal passes through the phase shifter again and obtains the frequency and phase shift. The frequency/phase transformed microwave signal will be $u_{ij3}(t) = A'_{ij}\, U_{i0}\sin\left[\left(\omega_{i0} + \Omega_j\right)t + k_{i0}d_{ij} + \varphi_{i0} + \varphi_{jL}\right]$, where A'_{ij} takes the transponder gain into account. The transponder gain only determines the operating distance of the system, and it does not affect the accuracy of object positioning. So, we will assume the transponder gain is equal to 1 ($A'_{ij} = A_{ij}$). The transponder reradiates this frequency/phase transformed microwave signal back in the direction of the beacon. In the beacon, the second microwave signal received will be $u_{ij4}(t) = A_{ij}^2 U_{i0}\sin\left[\left(\omega_{i0} + \Omega_j\right)t + k_{i0}d_i + k'_{i0}d_{ij} + j_{i0} + \varphi_{jL}\right]$, where k'_{i0} takes the frequency shift $\omega_{i0} + \Omega_j$ into account. The frequency shift Ω_j is much lower than the initial frequency ω_{i0} (e.g. $f_{i0} = \omega_{i0}/2\pi = 1.5$ GHz and $F = 10 - 100$ kHz), then $k'_{i0} \approx k_{i0}$. This second signal received is mixed with the original microwave signal, and at the mixer output the low-frequency signal of difference is selected. This low-frequency signal will be $u_{ij5}(t) = A_{ij}^2 U_{i0} \sin\left[\Omega_j t + 2k_{i0}d_{ij} + \varphi_{jL}\right]$. As we can see, the initial frequency ω_{i0} and the initial phase φ_{i0} of the original microwave signal are both subtracted in the mixer. Only the double phase progression $2k_{i0}d_{ij}$ of the microwave signal is of interest for distance definition. The low-frequency signals from each j^{th} transponder are obtained at the output of each mixer of each i^{th} beacon [9, 10], but the phase shift will be unique for each beacon-transponder pair, and it will be determined by each distance d_{ij}. As the frequencies of signals Ω_j from different transponders are quite different, it is inconvenient to measure the phase differences between these signals and the reference one. To avoid this problem heterodyning of the received signal is proposed. The frequency of heterodyne Ω_i in the i^{th} beacon is chosen so that the difference $\Omega_i - \Omega_j$ remains constant and the one is equal to 10 kHz, for example. A signal with such frequency is amplified up to a limit which will be described as $u_{ij6}(t) = U_0 \sin\left[\Omega_{ij} t + 2k_{i0}d_{ij} + \varphi_{jL} - \varphi_{iH}\right]$, where $\Omega_{ij} = \Omega_i - \Omega_j$, and φ_{iH} is the initial phase of the heterodyne signal. The phase of this signal is compared with the phase of low-frequency reference signals with the same frequency $\Omega = \Omega_{ij}$. So, the phase detector output data Ψ_{ij} is proportional to the value $\Psi_{ij} : 2k_{i0}d_{ij} + \varphi$, where φ is the sum of all initial phases of all the low-frequency oscillators. Thus, analysing the data Ψ_{ij} we can determine each of the distances d_{ij}. Generally, it is possible to measure a phase difference between 0 and 2π. The phase progression $k_{i0}d_{ij}$ will be represented as $2\pi n + k_{i0}\Delta d$, where n is an integer. In order to avoid this problem we sequentially change the operating frequency of the microwave oscillator of each beacon [11, 12] and we measure the phase differences between the reference low-frequency oscillator signal and low-frequency mixer output signal. Initially we fix this phase difference as $\Delta\varphi_1$ and fix the frequency as f_1. After that we change the frequency of the microwave oscillator till the phase difference becomes $\Delta\varphi_2 = \Delta\varphi_1 + 2\pi = \Delta\varphi_1$, then we fix the frequency f_2 and calculate the distance as $d_{ij} = c/2(f_1 - f_2)$.

4. Equipment Implementation

Transponders have the simplest design and the lowest power consumption. Besides the power supply chains and microcontroller, a transponder contains three microwave parts: the microwave antenna, the controlled transmission phase shifter of four/five-digits (16/32 steps), and one-port microwave transistor amplifier. The power consumption of these units do not exceeds a few milliWatts. The nanoWatt RISC microcontroller with crystal oscillator represents a low-frequency oscillator. Microcontroller outputs drive the directly control inputs of the phase shifter. The frequency of the crystal resonator represents the ID of the transponder. The value of the frequency step is determined by the pass-band of the low-frequency processing chains of the beacon. The transponder has a size of 120×120×20 mm^3. The power consumption of the transponder is about 50 mW, And power is supplied bys two A-size cells.

The cost of the beacon is higher, but the design remains as simple, see figure 2.

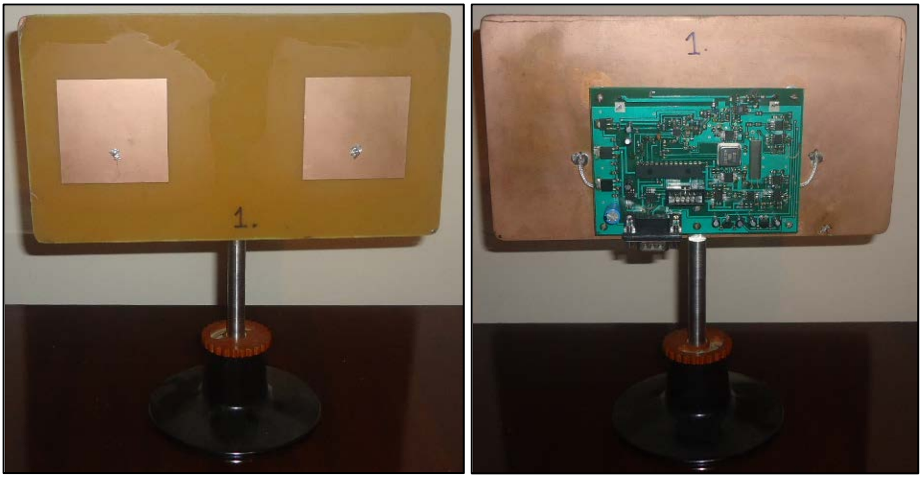

Figure 2. Appearance of the beacon

In a beacon we use two patch antennas on a single board rather than a Y-circulator and single antenna. Patches are separated by a certain distance. This technical solution ensures the better decoupling of the transmission and receiving paths. We obtained 40 dB decoupling. The size of the beacon is 120×180×30 mm^3. The large dimensions determine the antenna board. The system operation frequency is 1300 MHz. Processing chains are placed on a separate board. This board is directly attached to the antenna board. Two short microwave feeders are used for the board connections. The processing unit consists of simple microwave chains, low-frequency chains, and a microcontroller with a built-in CAN-module. The microcontroller determines the frequencies of the microwave oscillator and low-frequency heterodyne. By means of a built-in capture module it measures the phase difference between the low-frequency SALIM output signal and the interruption signal of its own oscillator. Then the raw data are transferred via a CAN-interface to the adapter module. The beacon will be installed on a support, or it can be directly mounted on a room wall. The patch ensures radiation in single hemisphere. The number of beacons on a single CAN-line can reach a large value. The transmission speed of the CAN-interface was chosen as 64 kbit/s, which ensures a length of CAN-line of 1 km.

The adapter module collects the raw data from the beacons via the CAN-interface and transmits this data to a PC via Ethernet. The simplest UDP protocol is used. This module also ensures the power supplying to the beacons. So, a 4-core cable is used for the connection of all units (two cores for power supply and two cores for the CAN-line). The power consumption of each beacon does not exceed 300 mW. The size of the adapter module is 80×110 mm2 (PCB) and it is 30 mm high.

5. Restrictions

Certainly, a complex indoor environment assumes multipath microwave propagation. The first patch of the beacon emits a microwave signal within the entire room space and the scattered microwave signals are received by another patch of the beacon. But these scattered signals do not interfere with the useful signal because the latter has been frequency shifted. Only received by the transponder the scattered signal obtains the same frequency shift, but this signal has much lower amplitude than the direct one. The presence of bulk metal in the room would disturb the normal system operation, as well as the operation of any other radio engineering system. The number of transponders operating simultaneously in a room is high as was discussed previously. But certain restrictions appear due to signal mixing. The combinatorial components can interfere with the useful signal. However, the careful choice of ID frequency will eliminate this problem. In any case, this problem would arise as a result of a large number of people in a room, which is a rare event.

6. Conclusion

The functioning of equipment for precision object positioning was discussed. The considered equipment possesses the simplest design and the lowest cost. At the same time, its metrological features are high. The calculation routines are quite well realised. The equipment installation does not demand extended manpower. The transponder, which is wearable by the elderly/disabled, does not generate any radio signals. It only receives and retransmits the microwave signal from the beacon(s). So the intensity of the electromagnetic field in a person's nearby environment is very low, and will thus not have an effect on human health. The theoretical investigations concerning the system's accuracy give optimistic results, which are confirmed by the author's previous experimental investigations in this field (Shirokov & Gimpilevich, 2010).

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RULE-BASED INDOOR LOCALIZATION USING NON-INTRUSIVE DOMOTIC SENSORS AND THE HOMER PLATFORM

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Abstract

The AIT Austrian Institute of Technology has developed a modular software platform named HOMER (HOMe Event Recognition System) providing services to enable independent living for elderly people at home. The platform is based on state-of-the-art software development techniques, such as OSGi and SpringDM, and addresses the interoperability aspect by interfacing several sensor networks and harmonizing incoming sensor data according to appropriate ISO standards. The system claims to be close to the market by using off-the-shelf sensor hardware from present global vendors of home automation products. Privacy of the resident is respected by using commonly accepted home automation sensors and completely avoiding more intrusive ones like video cameras, microphones or wearable devices. Based on sensor data, functionalities for the detection of specific events and situations in the home have been implemented using finite state machines and simple statistical methods.

1. Introduction

HOMER [1] is an open and flexible OSGi-based software platform which aims to integrate various home automation systems and the consequential event and situation recognition for smart homes (addressing comfort, energy efficiency, etc.) and Ambient Assisted Living (AAL) applications (addressing safety, autonomy, self-confidence, etc.). HOMER software is developed in Java and is executed within an Apache Felix OSGi framework [2]. Functionalities are encapsulated in terms of OSGi *bundles*. Along with OSGi, further supporting technologies like Apache Maven [3] and Spring Dynamic Modules [4] are used. Running inside a Java Virtual Machine indicates an independence from operating systems, except for the USB drivers for the sensor network gateways. Therefore HOMER can run on commercial PCs or Notebooks on several Java-enabled Operating Systems. HOMER Core components are exploited by installing the Open Source model (http://homer.aaloa.org).

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2. Integration of sensor systems

The HOMER platform is flexible in terms of the integration of various sensor devices through appropriate drivers, which can be Open Source or proprietary, depending on the field of application and availability. For the EvAAL competition the wireless sensor system Xcomfort from Eaton was used [5].

Xcomfort home automation system offers home automation sensors and actuators with RF-based communication channels. The wireless data communication protocol developed by Eaton uses the public frequency band of 868 MHz like many other similar systems. The protocol is the property of Eaton and is not freely available.

Sensors can be configured to directly control actuators in the same wireless network. Capturing all sensor data in a PC is facilitated by a wireless-to-USB gateway device, pictured in Figure 1.

The sensors are mainly battery powered, but a few wired versions are also in the Xcomfort product-line, which can be integrated with the power supply of the home (electrical power sensors) or plugged into power outlets. For the EvAAL competition, only passive infrared (PIR) sensors were used for location detection complemented by binary sensors with magnetic contacts, which are all battery powered (also shown in Figure 1).

Figure 1. Eaton Xcomfort sensors and gateway

Binary sensors from Eaton immediately emit a message when the attached magnetic contact is opened or closed. Motion detectors also immediately emit an ON message (motion detected), but have a 3 second delay for the OFF message (no-motion detected).

The Xcomfort wireless system does not restrict the number of devices. But the USB gateway is limited to only being able to manage 99 sensors, which is sufficient for most installations in a single flat. If more than 99 sensors are required for one installation multiple USB gateways can be used, each of them bound to a set of sensors (the HOMER platform supports multiple USB gateways).

3. Internal data model

For all sensor technologies connected a mapping to one central, standardised data model is applied. This is essential for further data processing in terms of event recognition and reasoning.

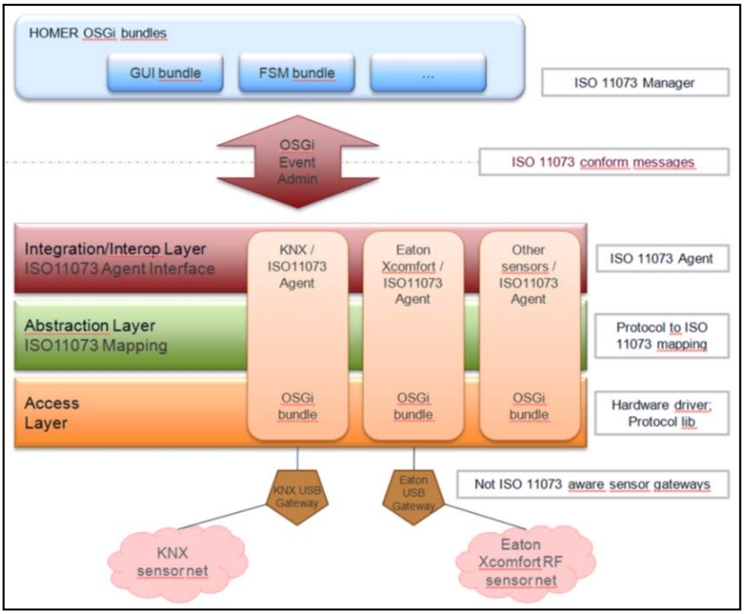

Figure 2. HOMER hardware integration architecture based on ISO 11073-10471

HOMER implements the ISO/IEEE 11073-10741 standard (Health informatics - Personal health device communication Part 10471: Device specialization - Independent living activity hub) as its primary internal data model. This standard is currently proposed by the Continua Health Alliance. The Continua Design Guidelines (version October 1, 2010) propose this standard for LAN (Local Area Network) and PAN (Person Area Network) devices. Common home automation sensors are specified in this standard, including Environmental Sensors (smoke, CO, water and gas), Motion Sensors, Contact Closure Sensors, Usage Sensors, Switch Sensors, and Temperature Sensors. Besides a list of device specializations, ISO 11073 also defines a Data Exchange Protocol and Communication Procedure between so-called *Agents* and *Managers*, which should establish a common layer of interoperability. In the future, sensors should integrate the *Agent* functionality within the device while connecting to a software-based *Manager* on a PC. At this time no home automation devices with such integrated *Agent* functionality were available on the market. Therefore HOMER hardware abstraction component interfaces various (proprietary) sensor devices and maps them to a standardised data model. The architecture of the hardware integration and data abstraction is shown in Figure 2.

Data messages from sensors are transferred to the HOMER platform through sensor gateways connected to the PC, either via a USB or serial port. In the abstraction layer (Figure 2) incoming sensor messages are harmonised in terms of mapping proprietary data packets (e.g. from the Xcomfort data protocol) to the Domain Information Model (DIM) specified in ISO 11073-10471. These harmonized messages are stored in a database and used throughout the HOMER platform for further processing.

4. Situation detection

The core component for rule-based reasoning in the HOMER platform is a Finite State Machine (FSM) engine. To this effect, the Open Source project *UniMod* (http://unimod.sourceforge.net) is integrated and extended with a graphical user interface to provide the easy manipulation of individual state machines.

Several state machines can run in parallel on one system. Basic elements of a state machine are *Event*, *Transition*, *Action* and *State*. Each state machine is graphically designed in the HOMER configuration editor. State machines are kept simple to accomplish single tasks. The internal structure allows a quasi cascading of state machines through so-called *System States*, i.e. a *System State* set in one state machine can act as an event trigger in another state machine.

The arrows in Figure 3 are transitions from one state to another. Triggers for this transition are usually messages from sensor devices. The desired sensor can be chosen graphically from the flat plan together with a specific message type (e.g. “on” or “off” for motion detectors or magnetic contacts). Usually several state machines run in parallel for various tasks, so one incoming sensor event can start transitions in multiple state machines.

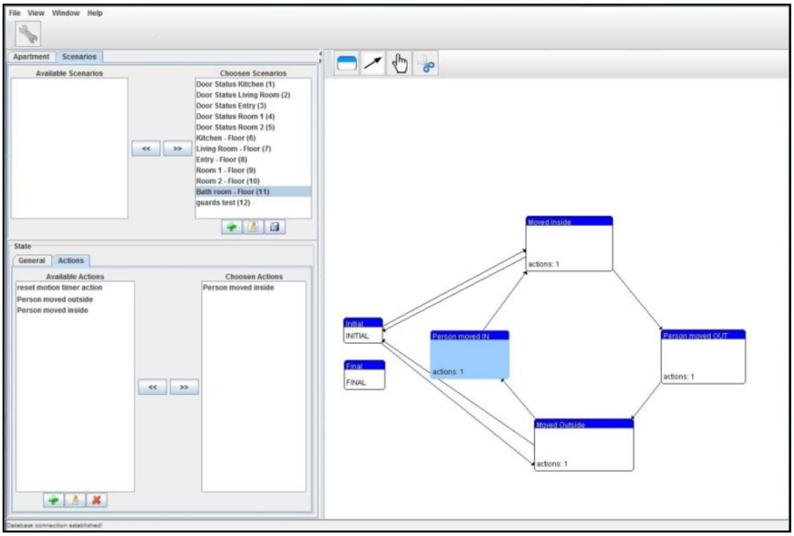

Figure 3. Configuration graphical user interface for state machines

An exemplary scenario is thus: One state machine is responsible for detecting the location of the inhabitant within two rooms of a flat connected by a door. There are motion detectors in each room complemented by a magnetic contact fixed on the door. According to the sequence of incoming sensor messages (motion on/off, door open/closed), transitions in the state machines are fired and states are activated. A state represents a certain situation in the flat, e.g. 'person is in room 1' or 'person is in room 2'. There are so called *Actions* bound to a state element. After a successful transition to a state the actions belonging to this state are fired. For example a message is sent to a specific actuator to turn on the light in room 1, a notification is sent via e-mail/SMS to a relative/system provider or an icon is changed on a graphical user interface in the flat.

With a set of state machines for various purposes the system can not only detect the location of a person but also situations like whether the person is at home/not at home; person is sleeping in bed; person is out of bed during the night longer than usual (based on timely thresholds); the front door is open for a certain period of time, and no motion is detected in connected rooms. To determine the current location of the inhabitant is always essential information for all of these scenarios. Alerts about the situations detected can be sent to persons or other systems, or can be represented on a homepage accessible by authorised individuals over the web.

5. Graphical user interface

HOMER consists of an extendable graphical user interface which features the configuration and design of the home environment, including sensors and actuators (see Figure 4) as well as logging and monitoring panels. The graphical user interface facilitates the creation and maintenance of a floor plan and positioning and assignment of sensors, as well as the configuration of state machines discussed in the last section.

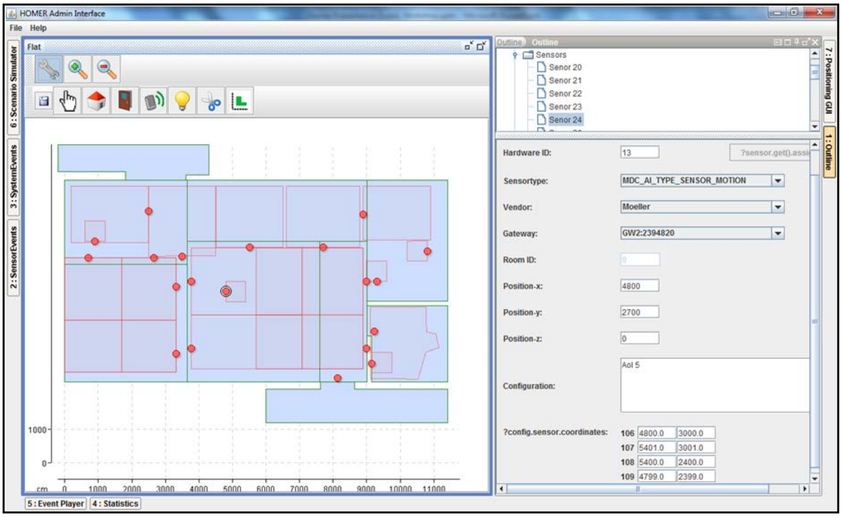

Figure 4. Configuration GUI for flat and sensors

6. Interfaces to external systems

Interfaces to external systems are realised by using established protocols like Email, SMS, HTTP requests, and remote OSGi or TCP sockets. There are several HOMER bundles implementing different interfaces to external systems (shown in Figure 5). For instance, after detecting a situation classified as critical an SMS alert could be sent to a relative and/or the alert can be sent to a web service of the service provider's central system/server over the Internet. These notifications are created from actions set up in the state machine configuration discussed in section 4.

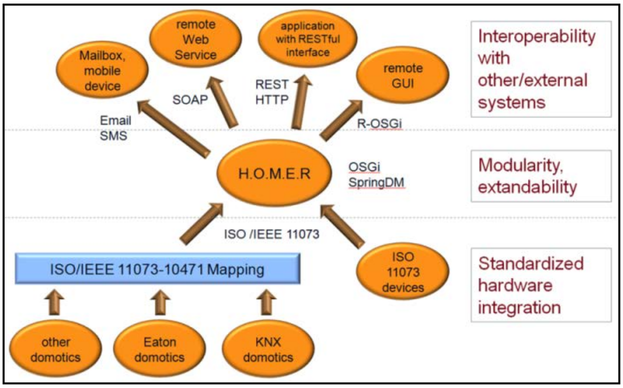

Figure 5. HOMER interface overview

7. Deployment for the EvAAL competition

A small, fan-less PC together with the Xcomfort USB gateway can be stored somewhere in the flat or in a control room, invisible to the resident. An Internet connection is only needed if notification features to external systems are desired, or remote control of the system is requested.

For the EvAAL competition mainly PIR sensors were used. They are battery powered and can be fixed by screws or double sided tape. The location of the sensors is completely flexible and does not depend on power lines or outlets. The majority will be placed on the ceiling. Additional sensors are placed on furniture where feasible. A set of magnetic contact switches is placed on doors and cupboards. The RF range between sensors and the USB gateway is up to 30 metres indoors, depending on the type of walls.

The sensing range of the Xcomfort PIR sensors is very large (up to an area of 4 x 3 metres) but can be decreased by placing a milky cover over the device with the use of non-transparent adhesive tape. In this way the sensing range of ceiling mounted PIRs (height at approx. 2.6 metres) can be reduced to a minimum area of 0.5 x 1 metres at floor level (e.g. for observing a door passage). Further, each PIR sensor can cover a certain area of the apartment. Particular areas will be monitored by two or more sensors simultaneously.

To cover the entire area of the CIAMI Living Lab approximately 20 PIR sensors were used. The resulting density of PIR sensors allows for a tracking accuracy of 2–3 metres inside the apartment.

The resident's location is detected with information from these non-obtrusive sensors without the use of any wearable device, nor any audio or video sensors. The positioning bundle is responsible for keeping track of a person's movements by highlighting defined sensor areas in the flat's plan due to incoming sensor events, and constantly calculates the walking path of the person. The current position is sent iteratively to the EvAAL evaluation system.

8. Experience from the EvAAL competition

The competition took place in the CIAMI Living Lab in Valencia (http://www.ciami.es/valencia). The deployment of all components took about 22 minutes (sensor installation and software set up). During the test sessions the system worked well without problems. Thanks to the good accuracy of the system as well as low installation complexity, high user acceptance and good integrability in AAL systems, the HOMER system won 2nd prize in this competition.

Acknowledgment

This research was accomplished within the context of the project "Know-how und Kompetenz-Aufbau im Bereich Smart Homes für sicheres und energieeffizientes Wohnen" initiated by the AIT Austrian Institute of Technology GmbH - Biomedical Systems. This research was partly funded by the AIT Austrian Institute of Technology GmbH and the Federal Republic of Lower Austria and was co-financed by the EC (EFRE).

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SHERLOCK: A HYBRID, ADAPTIVE POSITIONING SERVICE BASED ON STANDARD TECHNOLOGIES

Tomás Ruiz-López[1], José Luis Garrido[1], Carlos Rodríguez-Domínguez[1], Manuel Noguera[1]

Abstract

There is a large diversity of alternatives to be dealt with in the design and construction of positioning systems, each of them with different advantages and disadvantages. We present a design proposal which aims to provide reusable and adaptable support to Location-based Systems, by providing a positioning service composed of interoperable components. Hence the interest of the proposal concerns the combination of different methods, algorithms and technologies in run-time to take advantage of the benefits of each of them. For instance, the proposal enables AAL solutions to address indoor and outdoor positioning by the same service switching, both dynamically and automatically, between methods and technologies, and combine two different methods simultaneously to improve accuracy.

Keywords: Indoor Positioning, Service-Oriented Architecture

1. Introduction

Current innovations in mobile and Internet-based technologies have motivated the increasing interest in distributed location-based systems. These systems are able to adapt their behaviour, content or functionality depending on the user's location, measured by means of a positioning mechanism. Such a mechanism is widely available in outdoor environments thanks to the Global Positioning System (GPS). However, in indoor environments GPS is not able to provide the required level of accuracy. Thus several methods, technologies and architectures have been proposed, each of them appropriate to fulfil specific non-functional requirements [1].

In this paper, a design proposal for a positioning service, called Sherlock, is presented. The aim is to provide support for both indoor and outdoor positioning. The concern of this proposal is that given the previously mentioned variety of alternatives, it allows dynamic, automatic and seamless switching and combines different positioning

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methods and technologies, and can be deployed in the three usual architectures in which a positioning system can work. This combination of methods and technologies leads to better quality attributes of the service, e.g. more accurate results, since we count on measurements from different sources and several estimations are performed in different ways.

2. Design

In this section the design of the positioning service (Sherlock) is presented, taking into consideration the plethora of currently existing alternatives. The positioning service aims to be hybrid (i.e. it allows both indoor and outdoor positioning, combinations of positioning technologies and methods and its deployment in different architectures). The service can be accessed using standard technologies for Service-Oriented Architectures (SOA), like WSDL or OWL-S.

A. System Architecture

The Client-Server architecture allows the system to be split into two parts: the client, which is in charge of taking measurements from the signals it receives (e.g. measuring the Received Signal Strength of a radio signal), and the server, which is responsible for computing the estimated position [2].

As shown in Figure 1, the client and the server can be deployed in different ways to adopt the three usual architectures [3]. Note that when the client and the server are deployed separately, we need to use middleware to communicate between them. In this case, we use BlueRose [4], which is a middleware being developed by our research group and it is orientated to context-aware applications and ubiquitous systems, but other platforms supporting communications are also available (CORBA, RMI, SOAP), since communications are encapsulated in components which can be replaced in a transparent way.

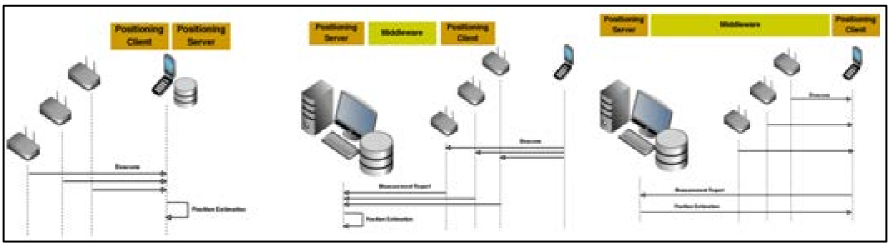

Figure 1. Service deployment in different architectures: terminal-based (left), network-based (centre) and terminal-assisted (right).

B. Signal measurement

Given the advantages and disadvantages of the different categories of positioning technologies, namely infrared, ultrasound, inertial and radio frequency, we are focusing on the latter category since these technologies are already widely available in many homes, at a low cost, and provide reasonably good results with regard to indoor positioning. The possibility of using more than one technology at a time and measuring different features from a signal has been considered. This is tightly related to the satisfaction of non-functional requirements: it can allow us to obtain more accurate results, since more measurements are available, and a more robust system, since the system does not rely on a single technology, and its eventual failure does not result in the system stopping.

In order to accomplish this task, the existing standardised technologies (Wi-Fi, Bluetooth, ZigBee, RFID [5]) were analysed and a common high-level abstract interface for all of them was designed. This interface allows the modelling of the behaviour of a measuring technology and integrating most of the currently available alternatives (as well as future developments which may improve indoor positioning) within the proposed positioning service. Additionally, measuring technologies modelled by means of the proposed interface are encapsulated into components that can be automatically switched or combined with the proposed service in order to satisfy different non-functional requirements.

C. Position estimation

Position estimation is done from the measurements performed in the previous steps. In a similar way to the previous section, the most prominent algorithms that can be applied to indoor positioning were examined (k-Nearest Neighbours, Neural Networks, Probabilistic-based techniques, Proximity-based techniques, Triangulation [1]) and a common interface model of the abstract functionality that a positioning algorithm must provide was designed. This mechanism allows encapsulating positioning algorithms in dynamically switchable components and to combine them depending on the desired quality attributes, like accuracy (combination of different algorithms increase the confidence in the estimation), responsiveness (some methods require more computation than others) or scalability (some techniques, e.g. scene analysis, require a long training phase which limits its scalability). The possibility of taking advantage of different positioning methods also increases the versatility of the system. Some of them require long training phases, which implies a long time of installation. A method that does not need training can be utilised (e.g. based on proximity) to provide positioning giving fair results while the system is still in the training stage for other methods, reducing the installation time and increasing the availability of the system.

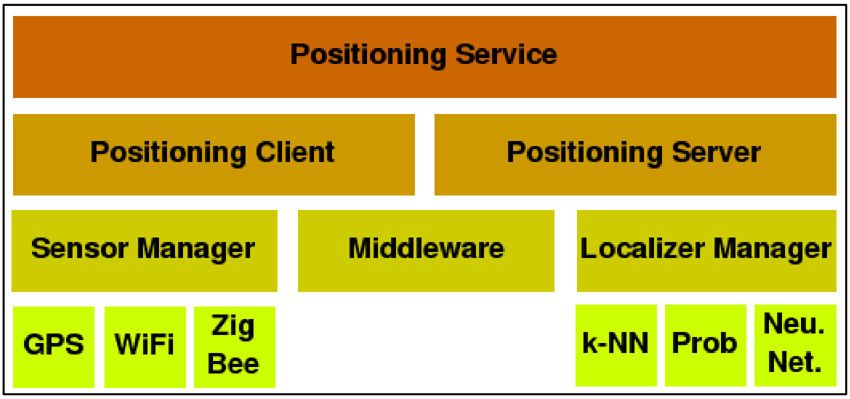

Figure 2. Layers of the positioning service

3. Results

The design was implemented and tested using ZigBee as a measuring technology (sensing the received signal strength, since it is easily available) and deploying it in a network-based architecture (since is the least invasive for the user). k-Nearest Neighbours [6] (selecting 3 and 5 neighbours) and a proximity-based technique were chosen as positioning algorithms. As for the hardware, Arduino boards (http://www.arduino.cc) were used, with a XBee module plugged into it, which is responsible for measuring the transmitted signal from the mobile unit, and a PC, with another XBee receiver (the coordinator of the network) was in charge of computing the locations. The size of the board is 6.85 cm wide and 5.33 cm of high. The coordinator is located in the living room, as indicated in Figure 3. The triangles represent the location of the fixed ZigBee receivers, and the crosses represent the points used to train the system. For each reference point, four measurements were taken and tagged with the corresponding location.

Tests were performed in an Ambient Assisted Living environment. Four base stations are in charge of measuring the radio signal. A mobile unit periodically transmits a signal in order to be located. The mobile unit is carried by a user (e.g. in his/her pocket) who has to be positioned.

The first test attempted to compare the different accuracies of the implemented positioning methods, varying their parameters (changing the number of neighbours, selecting between Euclidean and Manhattan distance as a similarity metric). We found that the 3-NN algorithm with Euclidean distance gave an accuracy greater than 90% at room level, whereas the proximity-based techniques barely reached 50% accuracy. The similarity criterion used was:

$$L_p = \frac{1}{N} \cdot \left(\sum_{i=1}^{N} |x_i - x'_i|^p \right)^{1/p}$$

The second test attempted to compare the extrapolation capabilities of these methods. The system endeavoured to position the mobile unit in some locations that were not present in the training set. Since symbolic locations are used neither of them gave the actual location, but again the 3-NN obtained an estimation which was closer to the actual position. The robustness of the service (switching down a signal transmitter) and the scalability (testing the accuracy before and after an expansion of the covered area) were also tested. In both cases the accuracy of each method suffered degradation (less than 80% of accuracy in k-NN).

Finally, accuracy degradation over time was tested by performing accuracy tests some weeks after training took place, and whether the accuracy degraded with movement, by tracking a person moving through the AAL environment. In the former case, similar values to those obtained after training were obtained. In the latter case, the predicted track presented incorrect estimations when the person was entering a new room, which suggests the need for some software or hardware mechanism to detect when people are in transition between two rooms (e.g. just at the door).

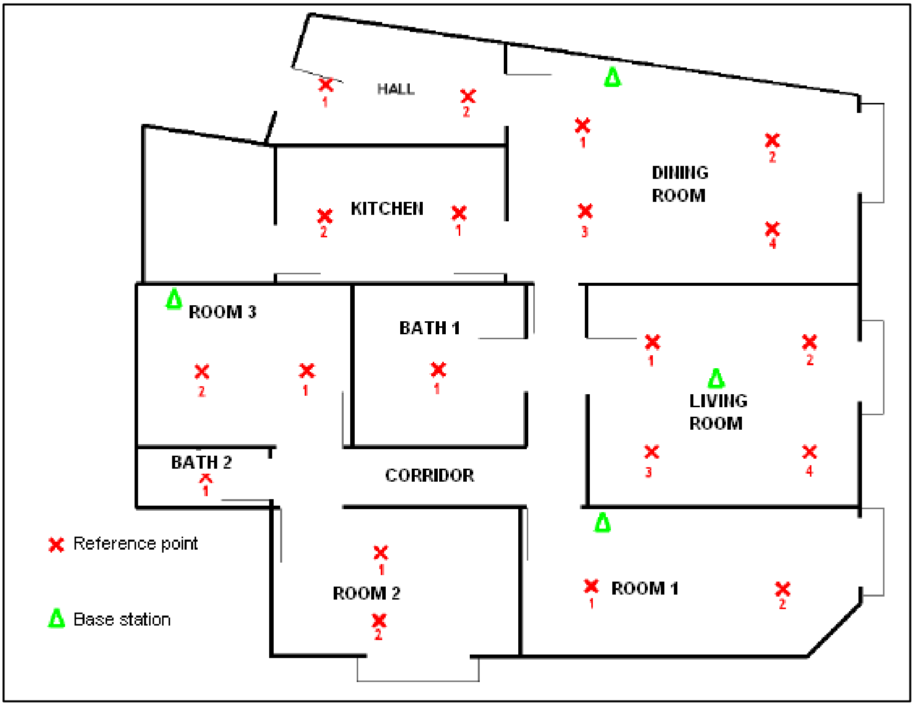

Figure 3. Test Scenario

4. Conclusions

This paper presents a reusable positioning service that aims to support the development of location-based systems. The same service is capable of providing in run-time both indoor and outdoor positioning, which could be a more realistic focus for AAL solutions, e.g. guided assistance for daily activities of elderly people should not only be limited to indoors. It can dynamically combine and seamlessly switch between different positioning methods and technologies, which allows the selection between the existing alternatives for the satisfaction of the expected non-functional requirements of the target application.

Components for positioning algorithms and technologies can be easily integrated within the service, even at runtime. This contributes to the extensibility of the system, and allows the testing of new configurations without the need to implement a whole positioning system.

To sum up, the benefits of this positioning system are:

- **Accuracy**: the combination of technologies and algorithms increases the confidence of the estimations since the system does not rely on a single source of measurements.
- **Installation complexity and availability**: this combination also allows deploying simple, fairly accurate methods which are easy and quick to install, while the required training for other methods is performed, which offers a higher level of availability. It is worth noting that Arduino boards are low-cost and easy-to-install widgets (they can operate/function as plug-and-play devices). The XBee modules do not consume a great amount of power while functioning, hence their batteries seldom need to be replaced.
- **User acceptance**: the user does not have to interact with the system; s/he just carries a device, which may be a small Arduino board with an XBee module transmitting a signal with a in-built GPS system. The network-based configuration also contributes to a less invasive system, since the base stations are concealed in the environment.
- **Integrability with AAL systems**: the devised service is intended to give reusable support to location-based services in an AAL environment. It allows interaction through standard mechanisms (WSDL, OWL-S) and makes use of standard technologies (IEEE 802 family protocols, GPS, RFID). It also provides a small library to develop new components to be integrated with and extend the system.

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THE ILOC ULTRASOUND INDOOR LOCALISATION SYSTEM WITH INTERACTIVE BADGES

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Abstract

iLoc is an ultrasound range based indoor localisation system which is deployed at the iHomeLab laboratory. For example, the system can be used for visitor tracking: Visitors get an electronic name badge comprising an ultrasound transmitter. This badge can be localised with an average accuracy of less than 10 cm deviation in its spatial position, by means of reference nodes distributed throughout the lab rooms. In this paper we report on the system itself and on the interactive badges. The badges are equipped with a cholesteric display, thus forming an ultra-low power locatable tag with a radio controlled information display. Depending on the position update rate, a small battery may suffice for several months of tag operation. Other advantages when compared to existing ultrasound ranging systems (like CRICKET, CALMARI, BAT) are for example its simple deployment with its 2-wire "IPoK" bus system.

1. Introduction

Ultrasound time-of-flight measurement is a proven technology for indoor ranging and has already been successfully applied to indoor localisation systems in the past. Prominent ultrasound based localisation projects are for example the CRICKET, CALAMARI and BAT systems [1, 2, 3]. They provide high and reliable accuracy, achieved with moderate effort. Known ultrasound systems are now some years old and the capabilities of embedded systems have evolved considerably since that time. The newly developed iLoc system takes advantage of developments, among others, in energy consumption, hardware size, cost, deployment effort and accuracy.

The iLoc ultrasound range based indoor localisation system (Fig. 1) comprises badges (name tags), detector nodes and a position server, as well as network infrastructure. The name tags (Fig. 3) are equipped with a microcontroller, a radio transceiver and an

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ultrasound transmitter. They emit ultrasound pulses at a configurable rate, for example 2 Hz, with a duration of 1 ms. These pulses are received by some of the detectors.

The detector nodes, also called reference nodes, are located at known fixed positions. They comprise a microcontroller and an ultrasound receiver as well as a 2-wire network connection to exchange data and time synchronisation information. The nodes record the reception times of the ultrasound bursts transmitted by the badges and transmit this information to an IP gateway via the 2-wire bus ("IPoK"; [4]). A server calculates position estimates from the received data by multilateration. In the iHomeLab, the position data is used among others for visualisation of visitor positions (see Fig. 4). An overview of some iLoc features is described by Knauth et al. [5].

A more detailed system layout is sketched in Fig. 2: The detector nodes are combined in groups of 10–15 devices (4 each drawn in the figure) to form one IPoK segment, linked with a "foxboard" embedded Linux system to an Ethernet infrastructure. Position calculation takes place at the iLoc server, from where the data is accessed by applications, for example for visualisation. Synchronisation and communication with the interactive badges is decoupled from the iLoc server and performed by a dedicated communication server, to increase the reliability of the system.

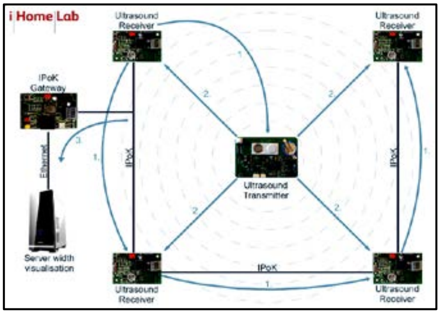

Fig. 1. Setup overview: four reference nodes are shown. The upper left receiver sends out a synchronisation signal (arrows labelled "1") by wire ("IPoK") to the other reference nodes and by radio to the mobile node (centre). The mobile node emits an ultrasound pulse (arrows "2") and the reference nodes record the reception time.

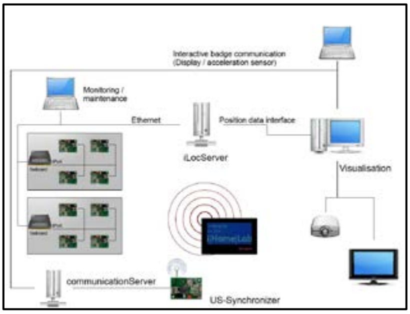

Fig. 2. System architecture: a badge emits a synchronised ultrasound burst. Reference nodes measure reception times and send them via IPoK to Ethernet gateways labelled "foxboard". From there they are sent to the iLoc server. The server calculates the badge positions. The communication server broadcasts synchronisation messages and handles the IEEE802.15.4 radio communication with the badges.

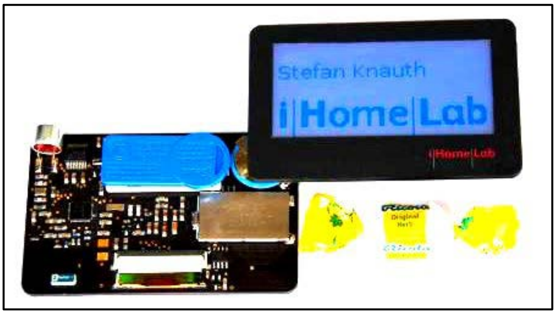

Fig. 3. Name badge with IEEE802.15.4 radio transceiver, ultrasound transmitter and cholesteric LCD

2. Hardware

A. Interactive badges

The interactive badge (Fig. 3) comprises the following hardware blocks: a CC2430 Texas Instruments microcontroller including IEEE 802.15.4 radio transceiver, antenna and HF matching network, a Bosch SMB380 triaxial acceleration sensor, a charge pump chip to generate a higher voltage (20 V) to drive the 40 kHz piezoelectric ultrasound transducer, the transducer itself, the cholesteric LCD unit, a rechargeable 25 mAh lithium battery as well as inductive charging circuitry. The power consumption of the badge hardware is in the range of 1–10 μW in standby mode and rises to about 50 mW in operational mode, with transition times < 1 ms. The microcontroller comprises a 32 kHz crystal-based wake-up timer.

The RF design and the sensor circuitry is adopted from our WeBee ZigBee radio module described by Klapproth et al. [6]. The LCD carries its own controller and is connected via a serial interface. Power to the display can be switched off by the microcontroller, while the content of the display remains visible. We observed that, depending on the environmental conditions (temperature, vibrations), the display content may actually decline. Therefore a display refresh should occur from time to time, for example once a day. Display- and g-sensor related data communication is carried out between the badges and the communication server by listening and answering to synchronisation radio packets which are described later.

The badges are equipped with an inductive battery charging circuitry, comprising a coil (part of the PCB layout), a rectifier and overvoltage protection. The badges are charged when put into their storage box, without the need to establish any electromechanical connections, for example by plugs or contacts. The storage box comprises two charging coils operating at a frequency of 125 kHz.

B. Reference nodes

The reference nodes are line-powered, and therefore minimal power consumption is not as crucial as for the badge. On the other hand, a large number of these devices have to be deployed and therefore installation and wiring should be as easy as possible. Therefore the design is considerably different from that of the badges, for example the use of a different microcontroller is worth noting. The reference nodes comprise a Freescale HCS08GB60 Microcontroller.

For communication between the nodes we chose ”IPoK” (IP over Klingeldraht), a protocol developed by us for the easy networking of small (in size and cost) embedded devices. The idea behind IPoK is the use of a 2-wire multipoint connection, as for example RS485, and also the supply of power via the lines. The IPoK bus carries a 7–30 Volt supply, which is decoupled from the lines by inductors and then converted to 3.3 Volts with a DC–DC converter. The data TX signal is directly coupled from the microcontroller. The HCS08 series of controllers offer a 20 mA line driver for the included UART, such that the controller can directly drive the line via a capacitor. When not sending, the UART line can be switched to high impedance and no external driver is necessary. For RX, the signal is AC coupled to a comparator or more easily to a pair of standard HC14 Schmitt-Triggers. This leads to a minimum hardware effort for the bus interface circuitry.

3. Operation, Timing and Synchronisation

The maximum detection range of the iLoc ultrasound signal is about 15 metres, corresponding to a maximum ultrasound pulse “livetime” of less than 50 msec. This live time is given by the transmitter ultrasound amplitude, the sound path loss, and the receiver sensitivity, and is a consequence of the specific iLoc device parameters and the sound frequency used of 40 kHz.

There several design approaches exist for ultrasound localisation systems with multiple mobile nodes. It is important to avoid ultrasound interference between the nodes (see for example [1]). One commonly used approach is to let the fixed infrastructure emit the pulses and send radio packets, identifying the sending node. This has some advantages, for example privacy. The mobile node can detect its position without the system knowing that the mobile node exists. Also the number of mobile nodes is not limited in this case as they are passive. A disadvantage of this approach is that the mobile node has to listen for a certain time to radio and sound messages before being able to detect its position.

A main design goal of the iLoc system is that the mobile nodes (currently the name badges) should consume as little energy as possible. Therefore we chose the opposite approach, using active mobile nodes and a passive detection infrastructure. The mobile nodes themselves emit the ultrasound pulse. For each node a 50 ms time slot is allocated, corresponding to the maximum lifetime of the propagating ultrasound pulse. The time needed for the position determination of n nodes is therefore $T = n \times 50$ms.

A typical number of nodes in our lab is n = 20, so the position update rate for the nodes is 1 Hz. Other update rates are configurable, for example 10 Nodes with an update rate of 2 Hz each.

To allow TDMA operation, the whole system is synchronised. As previously mentioned, the fixed nodes communicate via “IPoK” 2-wire cabling. The system comprises several “IPoK” segments, each connected via Ethernet to the iLoc server. Within the segments the nodes are synchronised by data packets via IPoK. Each segment comprises a dedicated node which receives radio synchronisation messages from a central time information transmitter, driven by the communication server.

The central synchronisation radio signal is also used by the mobile nodes (name badges) for synchronisation. To achieve a synchronisation accuracy of about 50 μs, the mobile nodes need to resynchronise every 2–5 seconds. In practice the operation is as follows: the synchronisation signal is sent with the slot rate, i.e. every 50 ms, also containing the number of the badge that will send a pulse in the current slot. For n = 20, the nodes therefore wake up every second just prior to the moment when they expect their next synchronisation signal. They listen for the synchronisation packet, readjust their clock, emit their pulse and go to sleep again. The whole sequence takes about 5 ms, leading to a duty cycle of 1/200. The electric current in active mode is about 20 mA, leading to an average current of about 100 μA, at a voltage of 2.5–3 V, enabling operation times of several weeks with a small lithium coin cell. The following table lists some operational times:

Battery type	Duty cycle	operational time
Lithium coin 25 mAh	1 sec	10 days
	10 sec	3 months
Lithium 500 mAh	1 sec	1/2 year
	10 sec	> 2 years
AA 2000 mAh	1 sec	2 years

Fig. 4. 3D visualisation of visitor positions in the iHome Lab. The positions are given as “hovering” cubes indicating the name of the badge wearer, embedded in a 3D visualisation of the iHomeLab.

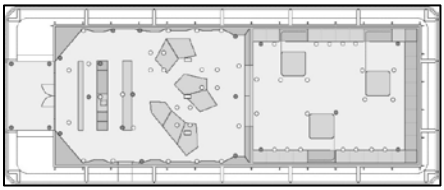

Fig. 5. Positions of the 70+ ultrasound receivers in the iHomeLab. The inner grey rectangle indicates the covered area (about 300 m2). The iHomeLab is located at Lucerne University of Applied Sciences at the Horw Campus**.**

4. Deployment in the iHomeLab

The maximum range of the iLoc ultrasound signal is about 15 metres. Basically, 3 range measurements from 3 different reference positions allow the determination of the tag position.

These conditions would be fulfilled when deploying the reference nodes in a lattice with a spacing of about 10 metres. Practically, depending on the desired accuracy, the density of reference nodes should be much higher, such that the distance to the furthermost node does not exceed approximately 5 metres. Then every point in the room is in the ultrasound range of more than 5 reference nodes, increasing the stability of the system against ultrasound interference, for example by noise emitted by machinery or people. The ultrasound signal needs a line-of-sight for propagation, which can get lost by shading caused by the body of the wearer of the tag, or by other visitors in the same room. Reflections also have to be taken into account.

In the lab currently more than 70 nodes are arranged in 6 IPoK bus segments (Fig. 5). Typically an emitted pulse is detected by about 5–15 receivers. Inconsistent range reports are rejected by the lateration algorithm with a simple but computing intensive procedure; from the reported ranges for all permutations of 3 readings a position value is calculated. By stepwise removal of calculated positions lying outside the mean value, the most probable readings are selected for the final lateration [7].

The deployment effort is kept at a reasonable level by using a 2-wire bus system, providing power supply and communication to the nodes. Such 2-wire systems are commonly used for building automation purposes, and are often referred to as "fieldbus". A variety of standards and vendors exist. As mentioned we did not opt for an existing fieldbus system but used our own implementation ("IPoK") to keep the bus interface hardware on the nodes simple.

In order to achieve a high system accuracy, the positions of the ultrasound receivers need to be accurately determined. Actually only a fraction of the positions have been laser measured. For the remaining positions only estimations have been entered into the database. Then the estimations have been adjusted by reference measurements: a mobile tag (name badge) was placed at a grid of known reference positions and time-of-flight results were recorded by the receivers. The position data of the reference receivers was then adjusted until the measured range values for a particular reference node best matched the calculated distances. This fitting process was performed by minimising the sum of the squared differences between the measured range and calculated range.

5. Applications

Acceleration sensor data is used by the fall detection application: if the badge measures unusual acceleration values it reports these values to the system. The fall detection application acquires position data from the iLoc server, analyses the data and situation and decides whether a fall alert shall be generated. A sample of such an alert screen is shown in Fig. 6. Also long term motion patterns of wearers can be recorded and analysed to detect unusual behaviour, like changes in wake-up time, slower motion speed, etc. which may indicate a medical threat.

In a setup where the system is used in a hospital or retirement home, context-relevant information may be indicated by the badges display such that a nurse nearby may immediately see relevant emergency medication or illnesses of the patient, which may have to be considered in emergency treatment. Of course, the system may also be used without a display, allowing the employment of smaller tags.

Another application in the area of assistance systems is the finding of assets. For example a medicine box, telephone, or glasses may be equipped with an ultrasound tag. If the owner cannot remember where he had placed these things, he may by some modality be informed about the current position of his belongings.

6. Results and Outlook

The iLoc indoor localisation system currently tracks, for example, 10 mobile nodes with a position update rate of two measurements per second per node, with an accuracy below 10 cm for single measurements with no temporal averaging applied. Fig. 7 shows data from a set of about 1500 subsequent measurement cycles, with at most 8 out of 9 reference nodes reporting timestamps. The right-most values include all measurements lying outside the graph's x-axis. During the recording of the observations, the sound propagation was intentionally disturbed by noise, i.e. people walking around thereby shielding the ultrasound reflectors. The high overall accuracy of the reported position values (95% within <2 cm) has been achieved by the careful determination of the sound velocity and position data of the reference nodes. Under less optimal adjusted conditions, the positioning error is still well below 10 cm.

The installation of the system is possible with moderate effort in typical indoor housing, warehouse or laboratory environments. The development includes not only the basic ranging electronics, but also system aspects and application software. Current applications of the system are visitor tracking and fall detection. The two-way radio communication enables, among others, applications in the field of ambient assisted living. Long term battery operation is ensured by strict TDMA operation. The iLoc system is installed in the iHome-Lab (www.iHomeLab.ch) at the Lucerne University of Applied Sciences. The focus of further applications in the iHomeLab will lie in the sector of ambient assisted living.

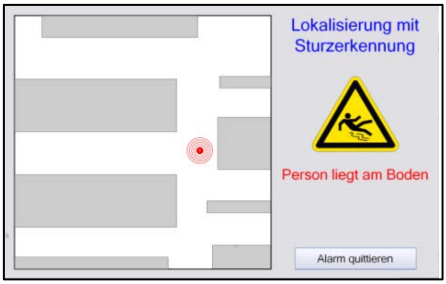

Fig. 6. Fall detection application: The name badges transmit acceleration sensor data to the system. In the case of a fall, an alert is generated, indicating the location of the incident

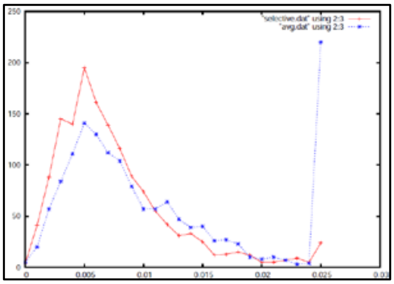

Fig. 7. Observed position error: dashed line (blue, *) indicates positions obtained by multilateration. Solid line (red, +) indicates positions calculated with trilateration and a selection algorithm. X-axis: metres, y-axis: number of results

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N-CORE® POLARIS REAL-TIME LOCATING SYSTEM

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Abstract

Context-aware technologies allow Ambient Assisted Living developments to automatically obtain information from users and their environment in a distributed and ubiquitous way. One of the most important technologies used to provide context-awareness is Wireless Sensor Networks (WSNs). WSNs comprise an ideal technology to develop Real-Time Locating Systems (RTLS) aimed at indoor environments, where existing global navigation satellite systems do not work correctly. In this regard, Nebusens and the BISITE Research Group of the University of Salamanca have developed n-Core® Polaris, a new indoor and outdoor RTLS based on ZigBee WSNs and an innovative set of locating and automation engines. n-Core® Polaris is based on the n-Core® platform, a hardware and software platform intended for developing and easily and quickly deploying a wide variety of WSN applications based on the ZigBee standard. n-Core® Polaris exploits the unlimited potential of the n-Core® platform, taking advantage of the advanced set of features of the n-Core® Sirius devices and the n-Core® Application Programming Interface. The main features of n-Core® Polaris include an extremely easy set-up and deployment; intuitive mobile and desktop interfaces; simple definition of restricted areas according to the users' permissions; and full integration with a wide range of sensors and actuators.

1. Introduction

People are currently surrounded by technology which tries to improve their quality of life and facilitate their daily activities. However, there are situations where technology is difficult to handle or people lack the knowledge to use it. Ambient Assisted Living (AAL) tries to adapt the technology to the needs of the people by means of omnipresent computing elements which communicate among them in a ubiquitous way (http://www.aal-europe.eu). In addition, the continuous advancement in mobile computing makes it possible to obtain information about the context and also to react

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physically to it in more innovative ways. Therefore it is necessary to develop new infrastructures that are capable of providing adaptable and compatible frameworks, allowing access to functionalities regardless of restrictions of time and location.

Wireless Sensor Networks (WSNs) are used for gathering the information needed by intelligent environments, whether in home automation, industrial applications or smart hospitals. One of the most interesting applications for WSNs is in Real-Time Locating Systems (RTLS). The most important factors in the locating process are the kind of sensors used and the techniques applied for the calculation of the position based on the information recovered by these sensors. Although outdoor locating is well covered by systems such as the current GPS (Global Positioning System) or the future Galileo, indoor locating still needs more development, especially with respect to accuracy and low-cost and efficient infrastructures [1]. Therefore it is necessary to develop RTLS that allow performing efficient indoor locating in terms of precision and optimisation of resources. This optimisation of resources includes a reduction in the cost and size of the sensor network infrastructure involved in the locating system. In this sense, the use of optimised locating techniques allows the more accurate determinaton of locations using even fewer sensors and with less computational requirements [1].

There are several wireless technologies used by indoor RTLS, such as RFID (Radio Frequency IDentification), Wi-Fi, UWB (Ultra Wide Band) and ZigBee. However, independently of the technology used, it is necessary to establish mathematical models that allow the position of a person or object to be determined based on the signals recovered by the sensor network infrastructure. The position can be calculated by means of several locating techniques, such as signpost, fingerprinting, triangulation, trilateration and multilateration [2]. However, they all must deal with significant problems when trying to develop a precise locating system that uses WSNs in its infrastructure, especially for indoor environments.

This paper is structured as follows: Section 2 explains the problem description, including a comparison between existing wireless technologies used to build RTLSs. Section 3 describes the main characteristics of the innovative n-Core® Polaris system. Finally, Section 4 presents the conclusions obtained so far.

2. Problem Description

The emergence of AAL involves substantial changes in the design of systems, since it is necessary to provide features which enable ubiquitous computing and communication and also intelligent interaction with users. The aim of AAL is to develop omnipresent computing by means of services and applications that use computing elements which can watch and communicate with one another (http://www.aal-europe.eu). AAL proposes new ways of interaction between people and technology, adapting the latter to people's necessities and the environment in where they are. This kind of interaction is achieved by means of technology that is embedded, non-invasive and transparent for users. In this regard, the users' locations given by RTLS represent key context information to adapt systems to people's needs and preferences.

RTLS can be categorised by its type of wireless sensor infrastructure and by the locating techniques used to calculate the position of the tags. This way, there is a combination of several wireless technologies, such as RFID, Wi-Fi, UWB and ZigBee, and also a wide range of locating techniques that can be used to determine the position of the tags. Among the most widely used locating techniques we have signpost, fingerprinting, triangulation, trilateration and multilateration [2, 3]. The set of locating techniques that an RTLS integrates is known as the locating engine [2].

A widespread technology used in RTLS is Radio Frequency IDentification (RFID) [4]. In this case, the RFID readers act as exciters continuously transmitting a radio frequency signal that is collected by the RFID tags, which in turn respond to the readers by sending their identification numbers. In this kind of locating system, each reader covers a certain zone through its radio frequency signal, known as the reading field. When a tag passes through the reading field of the reader it is said that the tag is in that zone.

Locating systems based on Wireless Fidelity (Wi-Fi) take advantage of Wi-Fi WLANs (Wireless Local Area Networks) working in the 2.4 and 5.8GHz ISM (Industrial, Scientific and Medical) bands to calculate the positions of the mobile devices (i.e. tags) [5]. A wide range of locating techniques can then be used for processing the Wi-Fi signals and determining the position of the tags, including signpost, fingerprinting or trilateration. However, locating systems based on Wi-Fi present some problems, such as interference with existing data transmissions and the high power consumption of the Wi-Fi tags.

Ultra-Wide Band (UWB) is a technology which has been recently introduced to develop these kinds of system. As it works at high frequencies (the band covers from 3.1GHz to 10.6 GHz in the USA) [6], it allows very accurate location estimations to be achieved. However, at such frequencies the electromagnetic waves suffer great attenuation by objects (e.g. walls) so its use with indoor RTLS systems presents significant problems, especially the ground reflection effect due the high frequencies used.

ZigBee is another interesting technology to build RTLS. The ZigBee standard is especially intended to implement WSNs and, as can Wi-Fi and Bluetooth, can work in the 2.4GHz ISM band, but can also work on the 868–915MHz band. Different locating techniques based on RSSI and LQI can be used on ZigBee WSNs (e.g. signpost or trilateration). Moreover, it allows the building of networks of more than 65,000 nodes in star, cluster-tree and mesh topologies [2]. ZigBee is, indeed, the wireless technology selected for our research.

Table I shows a comparison between the main wireless technologies when implementing RTLS. In this table can be seen a summary of the main advantages and drawbacks of RTLS, based on each technology.

3. n-Core® Polaris Real-Time Locating System

Based on a set of target features that an RTLS should addresses, Nebusens and the BISITE Research Group have developed n-Core® Polaris. n-Core® Polaris is an innovative indoor and outdoor RTLS based on the n-Core® platform, that features outstanding precision, flexibility and automation integration (http://www.n-core.info). The new n-Core® Polaris exploits the unlimited potential of the n-Core® platform, taking advantage of the advanced set of features of the n-Core® Sirius devices and the n-Core® Application Programming Interface (http://www.n-core.info).

The wireless infrastructure of n-Core® Polaris is made up of several ZigBee nodes (i.e. tags, readers and sensor controllers) called n-Core® Sirius B, Sirius D and Sirius A (http://www.n-core.info). They all have 2.4GHz and 868/915MHz versions and include a USB port to charge their battery or supply them with power. Likewise, the USB port can be used to update the firmware of the devices and configure their parameters from a computer running a special application on it. On the one hand, n-Core® Sirius B devices are intended to be used with an internal battery and include two general-purpose buttons. On the other hand, n-Core® Sirius D devices are aimed to be used as fixed ZigBee routers using the main power supply through a USB adaptor. In the n-Core® Polaris RTLS, n-Core® Sirius B devices are used as tags, while n-Core® Sirius D devices are used as readers. This way, n-Core® Sirius B devices are carried by the users and objects to be located, whereas n-Core® Sirius D devices are placed on ceilings and walls to detect the tags. Finally, n-Core® Sirius A incorporates several communication ports (GPIO, ADC, I2C and UART through USB or DB-9 RS-232) to connect to distinct devices, including almost every kind of sensor and actuator. All Sirius devices include an 8-bit RISC (Atmel ATmega 1281) microcontroller with 8KB of RAM, 4KB of EEPROM and 128KB of Flash memory and an IEEE 802.15.4/ZigBee transceiver (Atmel AT86RF230). Figure 1 shows a complete n-Core® Development Kit including all these kinds of device.

Table 1. Comparison between RTLS Technologies

Parameter	**Technology**			
	ZigBee	***Wi-Fi***	***RFID***	***UWB***
Frequency	868/915MHz, 2.4GHz	2.4GHz	125KHz – 915MHz	3.1GHz – 10.6GHz
Indoor accuracy	***	**	*	****
Detection range	***	**	*	*
Tag cost[a]	**	**	***	*
Total cost[a]	***	**	**	*
Ease of deployment	****	**	*	*
Tag autonomy	***	*	****	**

Parameter	Technology			
	ZigBee	***Wi-Fi***	***RFID***	***UWB***
Tag size[b]	**	**	***	**
Security	**	***	*	**

a. A lower cost implies a higher rating.
b. A smaller size implies a higher rating.

Figure 1. n-Core® Development Kit including n-Core® Sirius B, Sirius D and Sirius A devices used as tags, readers and sensor controllers, respectively, in the n-Core® Polaris RTLS

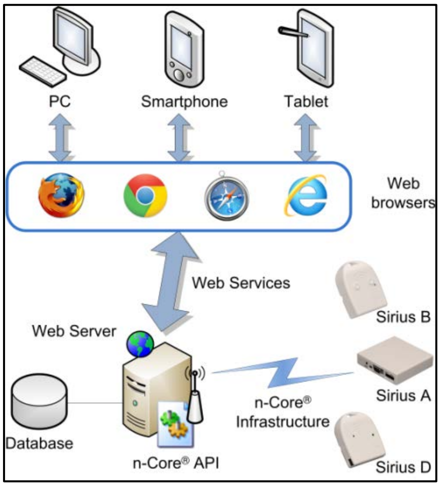

Figure 2. Web Services based n-Core® Polaris architecture allows access to its functionalities through different user interfaces

In Figure 2 the basic architecture of the n-Core® Polaris RTLS is illustrated. The kernel of the system is a computer that is connected to a ZigBee network formed by n-Core® devices. That is, the computer is connected to an n-Core® Sirius D device through its USB port. Such a device acts as a coordinator of the ZigBee network. The computer runs a web server module that makes use of a set of dynamic libraries, known as n-Core® API (Application Programming Interface). The API offers the functionalities of the ZigBee network. The web server module offers a set of innovative locating techniques provided by the n-Core® API. On the one hand, the computer gathers the detection information sent by the n-Core® Sirius D acting as readers to the coordinator node. One the other hand, the computer acts as a web server offering the location information to a wide range of possible client interfaces. In addition, the web server module can access a remote database to obtain information about the users and register historical data, such as alerts and location tracking.

The operation of the system is as follows. Each user or object to be located in the system carries an n-Core® Sirius B acting as a tag. Each of these tags periodically broadcasts a data frame including, among other information, its unique identifier in the system. The rest of the time these devices are in a sleep mode, so that the power consumption is reduced. This way the battery lifetime can even reach several months, with respect to the parameters of the system (broadcast period and transmission power). A set of n-Core® Sirius D devices is used as readers throughout the environment, placed on the ceiling and the walls. The broadcast frames sent by each tag are received by the readers that are close to them. This way, readers store in their memory in a table with an entry per detected tag. Each entry contains the identifier of the tag, as well as the RSSI (Received Signal Strength Indication) and the LQI (Link Quality Indicator) gathered from the broadcast frame reception. Periodically, each reader sends this table to the coordinator node connected to the computer. The coordinator forwards each table received from each reader to the computer through the USB port. Therefore, by using all these detection information tables, the n-Core® API, whose components are shown in Figure 3, applies a set of locating techniques to estimate the position of each tag in the monitored environment. These locating techniques include signpost, trilateration, as well as an innovative locating technique based on fuzzy logic.

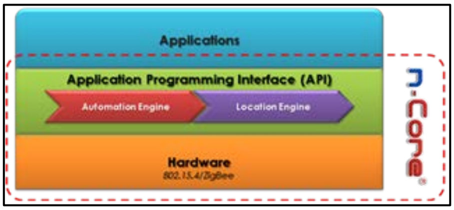

Figure 3. Main components of n-Core®, an integral hardware and software platform that includes ZigBee-based devices and an easy-to-use API including automation and location engines

Figure 4. Web client interface of the n-Core® Polaris system

Then, the web server module offers the location data to remote client interfaces such as web services HTTP (Hypertext Transfer Protocol) over SOAP (Simple Object Access Protocol). This way the n-Core® Polaris system includes three basic client interfaces: a desktop application, a web application and a mobile application. Figure 4 shows a screenshot of the web client interface. All these client interfaces have been designed to be simple, intuitive and easy-to-use. Through the different interfaces, administrators can monitor the position of all users and objects in the system in real-time. Furthermore, administrators can define restricted areas according to the users' permissions. This way, if a user enters an area that is forbidden to it, the system will generate an alert that is shown to the administrator through the client interface. In addition, such alerts are registered in the database, so administrators can check anytime if any user has violated its permissions. Likewise, administrators can query the database to obtain the location track of a certain user, obtaining statistical measurements about its mobility or the most frequent areas in which it moves.

Furthermore, users can use one of the general-purpose buttons provided by the n-Core® Sirius B devices to send an alert to the system. Similarly, administrators can send alerts from the system to a user or a set of users, who can confirm it receipt by using another button. The system not only provides locating features, but also scheduling and automation functionalities. The system can be easily integrated with a wide range of sensors and actuators using the variety of communication ports included in the n-Core® Sirius A devices. By means of the automation engine provided by the n-Core® API, the n-Core® Polaris system can schedule automation tasks, as well as monitor all sensors in the environment in real-time. All the information can be accessed through separate web client interfaces.

To sum up, the main features and benefits of n-Core® Polaris are:

- High scalability, thanks to the implementation of the IEEE 802.15.4/ZigBee international standard.
- Fast and simple deployment over the n-Core® platform.
- Robust infrastructure that includes encryption and self-healing mechanisms against possible failures.
- Higher accuracy than other ZigBee-based RTLS.
- Integration with sensors and actuators in the same infrastructure, which makes it a much more versatile alternative than other similar systems.
- Intuitive user interfaces that allow viewing the position of mobile elements in real-time, detecting accesses to restricted areas and managing alerts.
- Lower total cost compared with systems based on Wi-Fi or RFID, and much lower than those based on UWB.
- Higher tolerance to the presence of walls and obstacles than systems based on Wi-Fi and UWB.
- Sirius B devices provide much longer battery life (even months) compared with devices based on Wi-Fi and UWB.
- Its performance is not affected by Wi-Fi networks, thanks to the greater number of channels used.
- Frequency band is approved for its use in industrial and medical environments.
- Web Services based architecture that facilitates the integration of n-Core® Polaris with a wide range of applications, including mobile interfaces.
- Capability to create your own RTLS by means of the n-Core® API (Application Programming Interface).

4. Conclusions

Among the wide range of Wireless Sensor Networks applications, Real-Time Locating Systems are emerging as one of the most exciting areas of research. Healthcare, surveillance or work safety applications are only some examples of the possible environments in which RTLS can be exploited. There also are different wireless

technologies that can be used on these systems. The ZigBee standard offers interesting features over other technologies as it allows the use of large mesh networks of low-power devices and integration with many other applications, as it is an international standard using unlicensed frequency bands.
In this regard, n-Core® Polaris provides an important competitive advantage in applications where it is necessary to determine the location of people, animals or objects. Among its multiple areas of application are those of healthcare, industrial or agricultural sectors, as well as those related to security and Ambient Assisted Living. Its optimal indoor and outdoor functioning makes n-Core® Polaris a flexible, powerful and versatile solution.

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OWLPS: A SELF-CALIBRATED 3D WI-FI POSITIONING SYSTEM

Matteo Cypriani[1], Philippe Canalda[1], François Spies[1]

Abstract

OwlPS is an indoor positioning system based on the IEEE 802.11 radio network (Wi-Fi). Since 2004, our team OMNI have developed and experimented with various techniques (both from the literature and from our own work) for indoor and outdoor positioning. We mainly exploit RSSI fingerprinting and indoor propagation models, helped by information such as the building's map, the mobile's path, etc. Fingerprinting location approaches provide a 4 m mean error for 3-D positioning, with only 5 Wi-Fi access points deployed over an area of 300 m². The latest version of the system (v1.2) includes a self-calibrating mechanism that avoids the time-consuming manual fingerprinting phase and allows consideration of dynamic changes in the environment (human, climatic, etc.) when computing the location of mobile terminals.

1. Introduction

Indoor positioning is a hard task to achieve, because of multiple physical phenomena. All the techniques based on radio signals have a relatively poor accuracy because inside a building many multi-paths occur, and this induces an error in distance estimation. In order to have a good accuracy indoors, one can use line-of-sight methods such as lights, laser lights, ultra-sound, radio signals, etc. If there is at least one wall between the sender and the receiver it is necessary to use a support that is able to go through walls, such as radio signals. Much work has been conducted in the last few years to define the right positioning function, which delivers an accurate computed position using measurements including multi-paths.

Three main techniques are used to build an indoor positioning function using radio signals:

- propagation models, sometimes adapted for indoor environments [1, 2];
- fingerprint of the area and use of a comparison tool to define similar reception levels [3];
- geometric models using a description of the building structure.

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Propagation model-based systems are very fast to deploy, but their positional accuracy is weak. The fingerprinting method is quite slow to deploy, because you need to fingerprint the area as the initial step of your positioning function; but the position accuracy ranges between 1 and 10 metres, depending on the building complexity and the fingerprint meshing. The geometric model is very slow to deploy, because you need to define all the elements inside the building very accurately. The accuracy is quite good inside the building but the calculation function can be slow.

We chose to work mainly with fingerprinting methods, which give quite good results. The weak point of these approaches is the duration of the repository construction, but it also seems to be the easiest task to automate (see section 2.3).

2. The OwlPS platform

Open Wireless Positioning System (OwlPS) [4] is a Wi-Fi-based positioning system developed at the University of Franche-Comté; it is planned for release under a free software license (GPL-like) within a few months. It implements several positioning algorithms and techniques.

2.1 Architecture

The OwlPS architecture is composed of several elements:

- **Mobile terminals**, which are equipped with Wi-Fi cards: laptops, PDA, cell phones, hand-held game console, etc. They run the owlps-client software.
- **Access points** (APs), which capture the frames transiting on the Wi-Fi network, listening for any positioning request transmitted by the mobiles. They run the owlps-listener software, which uses the pcap library to capture the Wi-Fi frames. The RSSI values are extracted from the Radiotap (http://www.radiotap.org) header of each frame, therefore the network interface's driver must support Radiotap. It is possible to have as many APs as desired: as long as they are only listening to the radio network they do not cause any interference.
- **The aggregation server**, to which the APs forward the received positioning requests; its task is to gather and format these requests. It runs the owlps-aggregator software.
- **The positioning server** (or computation server), which computes the position of each mobile from information forwarded by the aggregation server, thanks to owlps-positioning software.

All the modules are designed and tested on GNU/Linux-based platforms[2]. The owlps-client module is not mandatory, it can be replaced (for instance on Java-based cell

[2] The owlps-client and owlps-aggregator modules are also built on BSD platforms. Some parts of the network-related code of owlps-listener are Linux-specific, so it would require a few adaptations to work on another operating system. owlps-positioning should be supported on any platform with recent versions of GCC and the Boost libraries.

phones) by any software that is able to send a UDP packet following the adequate data format.

Of course, a single machine can run several software modules; in general the aggregation and computation modules are installed on the same host. Except for owlps-positioning, the memory footprint of the modules is low enough to run on most embedded hardware[3]. The hardware requirements of owlps-positioning depend on the number of mobiles and APs, and on the positioning algorithm selected. With a low workload (e.g. one mobile and six APs), it can run on a low-end PC without difficulty.

With a high number of capture APs it is possible to have more than one aggregation server, each AP being configured to send the captured positioning requests to a given aggregation server. However, it is currently not possible to have more than one positioning server in a single deployment area.

Figure 1 summarises the four steps in the mobile position resolution:

1. The mobile submits a positioning request to the infrastructure. This request is a UDP packet containing the local time (when used to calibrate the system, it also contains the current coordinates of the mobile).
2. Each AP capturing the positioning request extracts the corresponding RSSI. Then it transmits a UDP packet to the aggregation server containing the received mobile information, the received SS, the timestamp of reception on the AP, and the mobile and AP MAC addresses.
3. The aggregation server receives the positioning requests forwarded by the APs. It gathers those corresponding to the same couple {mobile MAC address, request timestamp} and forwards them to the positioning server.
4. The positioning server analyses the information received from the aggregation server and computes the mobile's position; the computed position is then sent to the mobile (or processed in another way).

[3] Around 27 MB of virtual size (1 MB of resident memory) is required for the owlps-aggregator and 2.7 MB (1.2 MB resident) for owlps-listener.

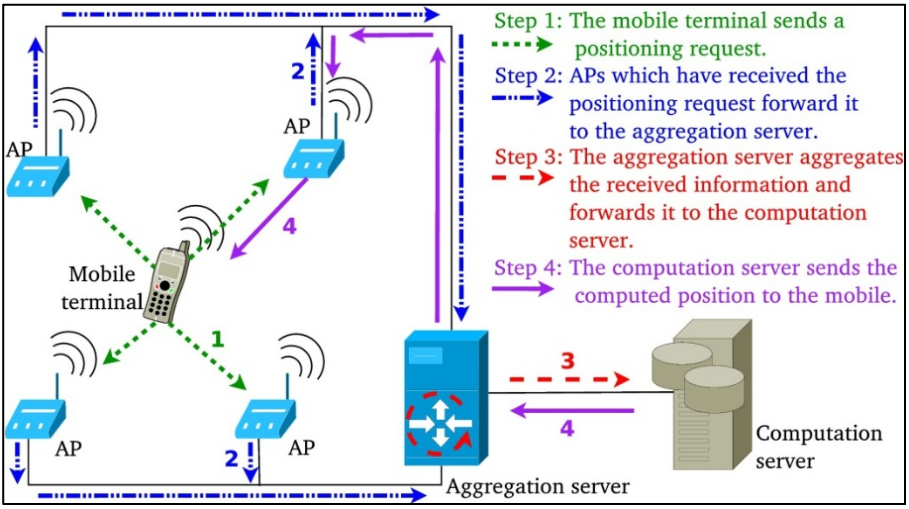

Figure 1: Four-step process of the mobile's position resolution

2.2 Deployment

The deployment of the system is reasonably straightforward. Here are the steps to follow.

1. Deployment of the APs in the area. They must be able to communicate with the aggregation server, either through a wired or wireless network.
2. Description of the hardware characteristics in the configuration files of the positioning server: antenna gain, transmitted power, coordinates of the fixed elements.
3. Optionally (depending of the algorithm used), description of the topology, or travel plan within the studied area.
4. Optionally, an initial, manual calibration of the system can be performed.

When running the system, one must also choose at least one positioning algorithm amongst those implemented in the positioning server.

2.3 Self-calibration

The OwlPS 1.2 release implements a self-calibration mechanism that allows the system to be operational within a few minutes after its deployment. Since the self-calibration is a continuous process, it also guarantees that the system is aware of any modifications that occur in the radio environment.

For instance, if the number of people present in the building changes, if those people move in the building, if furniture is moved, if the weather changes, etc., the system will take into account the changes in order to maintain good accuracy. On the other hand, with a static calibration the positioning error can rise dramatically if the environment changes.

When the self-calibration is activated, each AP regularly sends a positioning request (as if it was a mobile terminal), which will be intercepted by the others APs. The request is then processed in the usual way: it is transmitted by the APs to the aggregation server and, once aggregated, to the positioning server.

The positioning server is then able to build a matrix of the signal strength (SS) received by any from any (with $i \neq j$). Using this data, a second matrix representing the deployment area is built, that extrapolates the SS values to generate "calibration measurements" that can be used by algorithms like the Nearest-Neighbour (Bahl & Padmanabhan, 2000), as would be used by a real (manual) calibration.

3. Current experiment description

As a use case of OwlPS in this section we describe our current experimental deployment. We deployed OwlPS in a large room (10.50 m x 6.5 m) with four Wi-Fi APs (Fonera 2.0 running OpenWrt, which is an embedded Linux distribution) fixed to the wall near each corner of the room. The APs include a Radiotap-enabled Atheros Wi-Fi chipset, configured with MadWifi tools (http://www.madwifi-project.org). The aggregation and positioning software modules are both installed on an Asus EeePC running Debian GNU/Linux. Finally the located device is a Parrot AR.Drone (http://ardrone.parrot.com) which is a quadricopter running an embedded Linux kernel. This drone integrates horizontal and vertical cameras and an Atheros Wi-Fi chipset.

Figure 2 shows an annotated picture of the room and hardware. The superimposed image in the bottom-left corner is a view of the drone's horizontal camera.

All the modules communicate through an ad-hoc network; this is possible because the Wi-Fi interfaces of the APs support the simultaneous running of several modes (ad-hoc and monitor). If the Wi-Fi interfaces are in single-mode only, a wired (Ethernet) network can be set-up, or a second Wi-Fi interface can be added to the APs.

A roadmap is sent from a web interface to our software running inside the drone[4]. The positions computed by the system are then used by this embedded software to allow the drone to move by itself, following the roadmap provided by the user.

[4] This embedded software is called owlps-drone; it is derived from owlps-client and includes code to interact with the Parrot software in order to control the drone's movements.

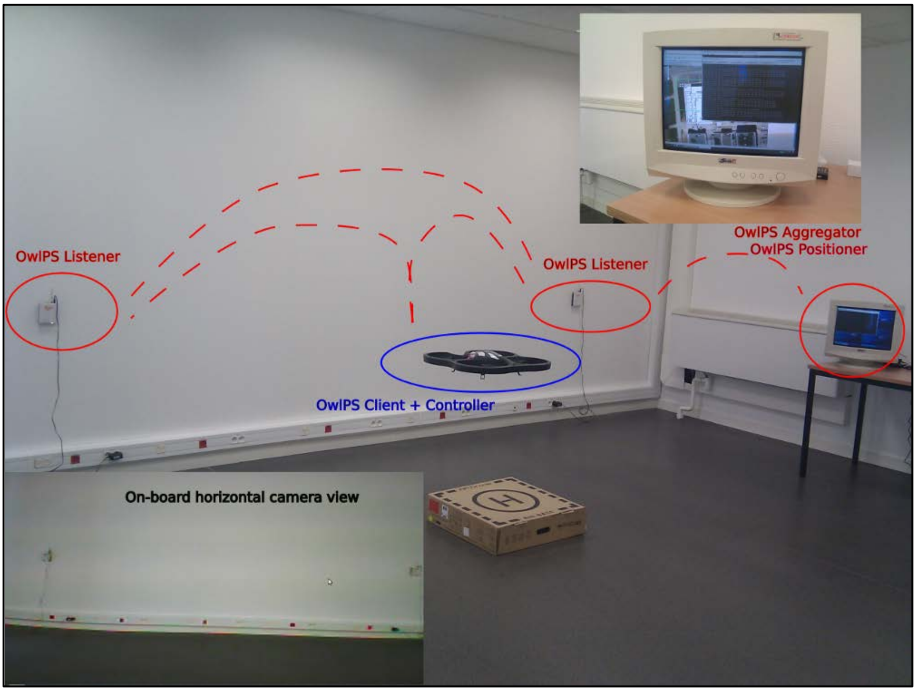

Figure 2: OwlPS platform and flying drone

4. Conclusion

In this paper we presented the main features of our Wi-Fi-based indoor positioning system. The most interesting features of OwlPS include a scalable and flexible architecture, the use of standard and low-cost hardware, and fast deployment. Furthermore, OwlPS will be released as free open-source software within a few months[5]. It is thus easy to deploy the system and implement additional positioning techniques.

The positioning software module is designed to be able to generate results for several algorithms from the same input data, so it is really simple to objectively compare the results. Moreover, it would be possible to deploy OwlPS on hardware using other radio networks (such as Bluetooth, ZigBee, WiMax, etc.) simply by rewriting some parts of *owlps-listener* (the signal strength extraction is specific for each medium). Changes to the aggregation and positioning modules, if required, would be minimal.

[5] We first need to complete the administrative procedure to be allowed to publish it, but we have already obtained the required authorisation.

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CAPFLOOR

Andreas Braun[1], Henning Heggen[1]

Abstract

Indoor localisation is an important part of integrated AAL solutions, providing continuous service to elderly people. They are able to fulfil multiple purposes, ranging from energy saving or location-based reminders to burglary detection. Combined systems that include localisation are particularly useful, as well as additional services e.g. fall detection. Capacitive sensing systems that allow the detection of the presence of a body over distance are a possible solution for indoor localisation that has been used in the past. However the installation requirements are usually high and consequently they are expensive to integrate. We propose a flexible, integrated solution based on affordable, open-source hardware that allows indoor localisation and fall detection, specifically designed for challenges in the context of AAL. The system is composed of sensing mats that can be placed under various types of floor covering that wirelessly transmit data to a central platform, providing localisation and fall detection services to connect to AAL platforms.

1. Introduction

INDOOR localisation systems have a number of applications in AAL that are not directly visible to the user but are available to other services, e.g. lighting based on location or context-aware systems that may prevent burglary, e.g. if the system detects a person entering a space in the proximity of a window. It is preferable that those systems are unobtrusively integrated into the living space and provide good recognition under many circumstances, e.g. looking at vision-based system the user may feel watched and systems may struggle under low light levels.

We are proposing a system based on capacitive sensors at floor level that allow localisation using low-intensity electric fields that detect the presence of a human body. They are invisible to the end-user and can be unobtrusively integrated into non-conductive materials. The focus of this system is flexibility using individual passive mats with electronic materials placed along the borders, allowing for easy maintenance and affordable construction. Using a specific electrode configuration it is possible to customise each mat to the conditions of the room by cutting off certain parts. Another

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advantage of this sensing system is that it can be used for other application scenarios, e.g. detecting the presence of a person lying on the floor to register falls.

2. Related Work

Capacitive sensors are a fairly old technology [1], able to detect the presence of an object by using the effect the said object has on a generated electric field. It is most commonly used in finger-controlled touchscreen devices [2] and material detection in industrial applications [3].

Floors equipped with sensors that allow the detection of objects is an area that has been researched in the past. We can distinguish pressure sensing systems that detect weight distribution changes or presence sensing systems like the one proposed. One example of pressure sensing systems is the ORL active floor [4] that is based on tiles directly placed on pressure sensors and uses a Hidden Markov Model based approach to detect footsteps.

SensFloor [5] is a capacitive sensor-based system comprised of carpet tiles with integrated electronics that wirelessly communicate with a central system. It is a precise system able to distinguish individual footsteps and has been marketed as a fall detection system.

3. CapFloor Hardware

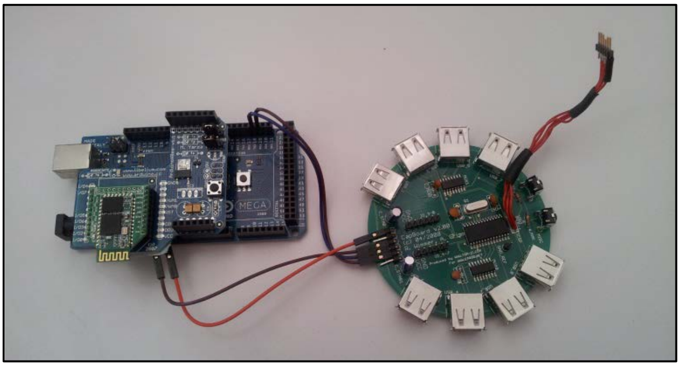

Figure 1 CapToolKit with Bluetooth Arduino

The CapFloor prototype is based on the open source hardware CapToolKit (http://www.capsense.org), providing a control unit that supports up to eight sensor elements for capacitive sensing. The device uses a firmware that has been optimised for controlling the CapFloor. The system is additionally available in several variants; one transfers data via USB, the other uses an Arduino (http://www.adruino.cc) system with attached XBee Shield [6] and Bluetooth Bee [7] to transmit data using the Bluetooth Serial Port Protocol. This second version is shown in Figure 1.

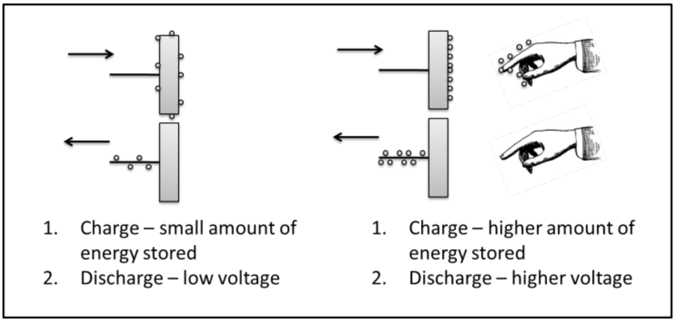

Figure 2 Capacitive proximity sensor

The system is an 8-channel single-electrode capacitive proximity sensor controller. The working principle is shown in figure2. Conductive, grounded objects that enter the electric field excited by the electrode increase the capacity of the electric field. The energy is highest if the object is large and the distance to the electrode is small. One very simple model is a two-plate capacitor, the capacitance *C* of which is given by the following equation with ε_o being the electrical constant, ε_r the relative permittivity between the plates, *A* the size of the plates and *d* the distance.

$$C = \varepsilon_0 \varepsilon_r \frac{A}{d}$$

Concerning the human body there is no analytical solution regarding the capacitance relative to an electrode [8]. Typically it is modelled using the two-plate model or by considering the human body as a sphere.

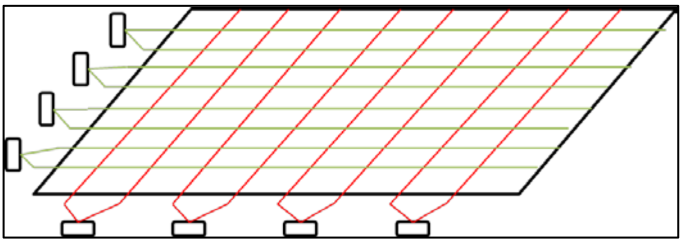

Figure 3 Conceptual drawing of the CapFloor electrode and sensor configuration

For the prototype we used passive floor mats of a rectangular shape equipped with active sensor elements on two adjacent outer sides. The size of the floor mats is variable, and one mat is able to cover several square metres of floor, e.g. the prototype has an area of approximately 6 m².

The electrodes are applied in two layers that are insulated from each other by the use of insulated wire. Two wires are connected to each electrode in order to increase the spatial range of a single sensor. With this technique each sensor is able to cover a width of approximately 50 cm. The distance between the wires has to be chosen in such a way that the typical human foot will always be placed on a wire.

Due to the chosen electrode configuration it is also possible to adjust the shape of the floor mats without changing anything concerning the electronic configuration. The mats can simply be resized to almost any convex shape, e.g. to place them in the corner of a room or to fit several mats into one room. The cutting of the wires affects the sensor response, yet we can use compensate for this via the software to account for the different response curves.

For ease of installation the floor mats are designed to transmit the sensor data wirelessly to a central station, which runs the CapFloor software. This minimises the wiring necessary and thus avoids additional work and cost during installation and guarantees an unobtrusive integration into the living space. For this wireless transmission we use the previously mentioned Bluetooth-based system on an Arduino microcontroller.

4. CapFloor Software

The CapFloor software performs various tasks. Low-level data processing is used to improve the noisy sensor signals. It allows modelling of the room from individual mats, taking into account their shape and orientation. Signals from different sensors are uniquely identified and used to create an overall picture for fully-equipped and modelled rooms.

The low-level data processing consists of the following parts:

- Average filtering of the sensor signals using a configurable amount of samples.
- Baseline calibration to determine the normal operating level of each sensor.
- Normalisation based on the baseline and tracking of minimum and maximum measurements during run-time.

The software provides two main services. A localisation service provides other services with the position of a user in the current environment. This information is generated in a two-step process. The software individually performs individual localisation for each mat. We use a weighted-average algorithm to determine the interpolated location in each sensor layer.

$$\bar{x} = \frac{\sum_{i=1}^{n} v_i x_i}{\sum_{i=1}^{n} v_i} \quad , \quad \bar{y} = \frac{\sum_{i=1}^{n} v_i y_i}{\sum_{i=1}^{n} v_i}$$

The resulting location ($\bar{x}, \bar{y}$) is calculated using the sums over the sensor positions (x_i, y_i) and sensor values v_i as weight. This allows us to improve the resolution of the system, which uses simple activity thresholds on the sensors.

If an object is detected the location is then mapped to the environment using knowledge of the mat's position and orientation, as well as the known parameters of the equipped space. This allows the global localisation of objects and the tracking of their movement throughout the environment and over different mats.

Furthermore the system uses a rule-based heuristic system to improve the localisation by ignoring impossible sensor readings (false-positives) and resolving ambiguous sensor readings. This component is uses historical sensor and location data to evaluate the rule set. One example of a false positive would be the registration of a person in the middle of a room without registering his entrance. In this case the system would discard the detected position unless the change is consistent for a certain amount of time. An example for ambiguous sensor data is distinguishing between several people standing close to one another and a single person lying down, which might cause similar sensor output. We resolve such situations by tracking the people throughout the room – if there are three people in one room and they are moving towards each other and come to a standstill this will not be counted as a person lying. These rules are currently hardcoded into the system.

The second main service is fall detection. The signal generated by a person lying down is significantly different from a person walking. This effect uses combined measurements over several adjacent mats, to allow the detection of falls that result in a person lying on several mats. This service can be connected to an alarm that asks the user if everything is well, or will automatically call for help if a person is lying for a certain amount of time.

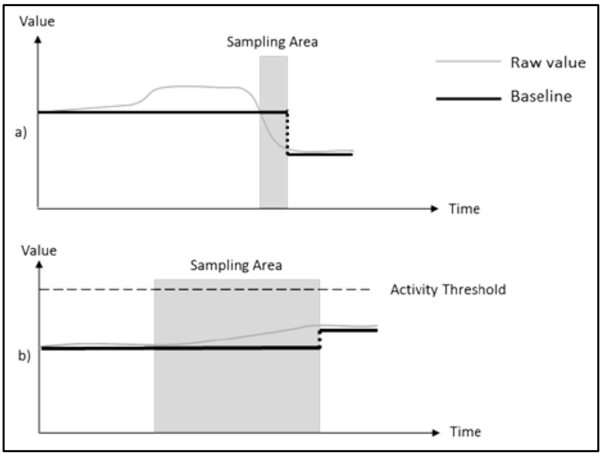

Figure 4 Drift compensation of the baseline: a) Low baseline reset b) Threshold based sampling & adjustment

A challenging aspect of working with capacitive sensors is proper calibration. The signals vary based on the environment and also drift over time, e.g. as a result of temperature or humidity changes. Both effects are taken into account in the software created, providing drift compensation over time, as well as remote calibration. As shown in Figure 4, the drift compensation uses two different patterns. The low baseline reset is started as soon as the sensor values drop below the baseline. Short-term sampling follows (to prevent outliers) and the baseline is set to the new smallest value. The threshold-based sampling adapts long-term changes of the baseline by using an activity threshold – a minimal value that is considered when a body is approaching the sensor – and a long-term sampling of sensor values that are below this threshold. In that case the baseline is increased.

Remote calibration is required when permanent changes are occurring in the environment, e.g. when new furniture is placed in the room. Affected individual mats or the whole room can be recalibrated to the new parameters by taking a larger number of samples and calculating a new baseline.

The capacitive sensor system has been connected as a service to the universAAL (http://www.universaal.org) AAL platform already used in previous work, installing capacitive sensors into an occupation-detecting couch.

5. Conclusion & Limitations

We are proposing a flexible floor-based indoor localisation system based on capacitive sensing that is specifically designed to detect the position and potential falls of users in a home environment. The focus was on creating a system that is precise enough for the desired tasks, while remaining affordable and easily maintainable. Other available solutions offer greater precision but are often technically complex, thus requiring extensive hardware installation which is not suited for all environments.

However this focus leads to some limitations. The system is currently not viable for large empty spaces, due to a limited maximum mat size and the sensors that have to be placed at the border.

As future work, we intend to further the creation of the currently hard-coded rule system that adapts the localisation, to allow end-user configuration, as well as to improve the detection of multiple individuals. Furthermore, we will try to improve the overall system to also allow larger rooms to be equipped.

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EVALUATING AAL SYSTEMS THROUGH COMPETITIVE BENCHMARKING (EVAAL) – TECHNICAL ASPECTS OF THE FIRST COMPETITION

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Abstract

EvAAL (Evaluating AAL Systems Through Competitive Benchmarking) is an international competition aimed at the evaluation and assessment of Ambient Assisted Living systems, components, services and platforms. In 2011 the first EvAAL event took place, on the specific theme of Indoor Localisation and Tracking for AAL. This paper describes the technical aspects of the first experience of EvAAL, and sketches a roadmap for future events.

1. Introduction

The evaluation and comparison of complex Ambient Assisted Living (AAL) systems is still far from being a reality [1]. On the other hand, the evaluation and assessment of components, services, and platforms for AAL systems is essential to ensure the progress and, ultimately, the success of AAL technologies.

EvAAL is an international competition on AAL supported by the AALOA association (http://www.aaloa.org) and organised by the universAAL project (http://www.universAAL.org). It aims to advance the state-of-the-art in the evaluation and comparison of AAL platforms and architectures. In particular, EvAAL aims to generate an environment in which researchers, students, practitioners and industries can compare their solutions and together build methodologies and approaches that make such a comparison possible. Since at present the complexity of AAL systems makes their full comparison impossible, EvAAL adopts a gradual approach, by dividing the problem into sub-problems, and by deferring the whole problem when the knowledge on AAL systems evaluation is more developed. Specifically, the first EvAAL events are to promote competitions on specific AAL components, in order to

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create data sets, benchmarks and evaluation methodologies. Then, based on the knowledge built during this phase, subsequent instances of EvAAL will focus on more complex (and possibly complete) AAL solutions.

In the first instance it was chosen to organise a single track competition on the topic "Indoor Localisation and Tracking". Localisation was chosen because it is a key component of many AAL services. Recent years have witnessed an increasing trend of location-based services and applications. In most cases, however, location information is limited by accessibility to Global Navigation Satellite Systems (GNSS), largely unavailable for indoor environments. The scope of this competition is to acknowledge the best indoor localisation system from the point of view of Ambient Assisted Living (AAL) applications.

For administrative reasons, EvAAL 2011 was organised in two major events: the actual competition organised at the CIAmI Living Lab in Valencia (Spain) (http://www.ciami.es/valencia) on the 27th-29th July, and the concluding workshop held in Lecce on the 26th of September (the workshop was a side event of the AAL Forum (http://www.aalforum.eu)). This provided the opportunity for each competitor to have access to the Living Lab for a long time slot (3 hours), during which they were able to install, test and uninstall his/her system.

This paper presents the technical aspects of this first EvAAL event by discussing the evaluation criteria, the benchmarks and the results of the competition.

2. Evaluation criteria

In order to evaluate the competing localisation systems EvAAL used a set of criteria, weighted according to its relevance and importance to AAL applications. For each criterion, each competing artefact receives a score, that can either be measured by direct observation, or, when direct measurement is not possible, is determined by the Evaluation Committee, a committee composed of volunteer members of the Technical Program Committee (TPC) who were present during the competition at the Living Lab.

The criteria (along with the respective weights) are as follows:

<u>Accuracy (weight: 25%):</u> each localisation sample produced has been compared with the reference position and the error distance has been computed. Each localisation system produced a stream of tuples, one sample every half a second. Specifically, the accuracy has been evaluated for each phase as:

- Phase 1: The accuracy in this case was measured as the fraction T of time in which the localisation system provides the correct information about the presence or not in a given AoI, the final score was given by 10*T.
- Phase 2: The stream produced by competing systems has been compared against a logfile of the expected position of the actor. Specifically, we evaluated the individual error of each measure (the Euclidian distance

between the measured and the expected points), and we estimated the 75th percentile P of the errors. In order to produce the score, P has been scaled in the range [0,10] according to the following formula:

Accuracy score = 0	if P >4 m
Accuracy score =10	if P <= 0,5 m
Accuracy score =4*(0.5-P)+10	if 0,5m < P <= 2
Accuracy score =2*(4-P)	if 2m < P <= 4

Installation complexity (20%): a measure of the effort required to install the AAL localisation system in a flat, measured by the evaluation committee as the total number of man-minutes of work needed to complete the installation. Thus a measure of the time T necessary to install the localisation system. The time T was measured in minutes from the time in which the competitor entered the living lab to the time at which they declare they have completed the installation (no further operations/configurations of the system will be admitted after that time), and it was multiplied by the number of people N working on the installation. The parameter T*N was translated into a score (ranging from 0 to 10) according to the following formula:

Installation Complexity Score = 10	if T*N <=10
Installation Complexity Score = 10 * (60-T*N) / 50	if 10 < T*N <= 60
Installation Complexity Score = 0	if T*N >60

User acceptance (20%): expresses how much the localisation system is invasive in the user's daily life and thereby the impact perceived by the user. This criterion is qualitative and was determined by the evaluation committee, taking into account a predefined list of questions.

Availability (15%): fraction of time the localisation system was active and responsive. It is measured as the ratio between the number of localisation data produced and the number of expected data. In both the first and second phases, each localisation system was expected to provide one sample every half a second, hence the number of expected samples is given by the duration of the test * 2. The values of availability A has been translated into a score (ranging from 0 to 10) according to the following formula:

Availability score = 10 * A

Integrability into AAL systems (10%): The score ranging from 0 to 10 was given by the EC: 2 points for the availability of libraries for integration; 2 points for the use of open solutions for libraries; 2 points for the use of standards; 2 points for the availability of tools for testing/monitoring of the system; 1 point for the availability of sample applications; 1 point for the availability of documentation.

3. Benchmarks

The score for measurable criteria for each competing artefact has been evaluated by means of benchmark tests. To this end each competing team has been allocated a time slot of three hours, during which the benchmark tests had been carried out. The benchmark consists of a set of tests, each of which contributes to assessment of the scores for the artefact. The Evaluation Committee controlled all the operations to ensure the fair evaluation of each artefact.

The time slot assigned to each competitor was divided into three parts:

- In the first part, the competing team deployed and configured their artefact in the Living Lab. This part should last no more than 60 minutes and its duration is measured in order to produce the score for installation complexity.
- In the second part the benchmark is applied. During this phase the competitors only had the opportunity to perform short reconfigurations of their systems. In any case, this part should be concluded within 60 minutes.
- In the last part the competitors must remove the artefact from the Living Lab in order to enable the installation of the next competing artefact.

Competing teams who failed to meet the deadlines in part 1 have been given the minimum score for the installation complexity.

During the second part, the localisation systems were evaluated in two phases:

Phase 1. In this phase each team must locate the user (impersonated by an actor) inside an Area of Interest (AoI). The AoI in a typical AAL scenario could be inside a specific room (bathroom, bedroom), in front of the kitchen, etc. Each system is requested to identify 5 Areas of Interest (AoI) (see Figure 1). The actor moved along random paths and stopped at each AoI for 30 seconds.

Phase 2. In this phase the artefacts should localise and track the actor as it freely moves in the Living Lab. During this phase only the actor to be localised was inside the Living Lab. In this phase each localisation system produced localisation data with a frequency of one new item of data every half a second (this has also been used to evaluate availability). Each system was requested to track the actor along three different paths (Figure 2) that was the same for each test, and that was not disclosed to the competitors before the application of the benchmarks. The first path was 36 steps in length, the second path 52, and the last one 48. Moreover, all the paths were characterised by 3 waiting points, i.e. the actor stayed in the same position for 10 seconds. The evaluation criteria of accuracy and availability have been computed on the three paths. Each test lasts up to a couple of minutes.

Figure 1. The Areas of Interest deployed in the Living Lab

Figure 2. The three different paths: path 1 (orange line), path 2 (green line), and path 3 (magenta line)

4. Results

At the Ciami Living Lab 6 teams challenged themselves in the competition, namely n-core Polaris (from the University of Salamanca), AIT (from the Austrian Institute of Technology), iLoc (from Stuttgart University of Applied Sciences and iHomeLab at the Lucerne University of Applied Sciences), OwlPS (from the University of Franche-Comte), GEDES-UGR (from the University of Granada), and SNTUmicro (from Sevastopol National Technical University). Table 1 summarises the scores obtained by the different competitors. In particular, n-Core achieved the best overall scores, since it received the best scores for availability, installation complexity and user acceptance. Since this localisation system is based on Received Signal Strength (RSS), the accuracy score was third with respect to the other systems. The best localisation system with respect to accuracy was AIT with infrared technology, followed by the ultrasound devices of iLoc. The n-Core team won since it was the system that, on average, obtained the highest score in all the metrics, while AIT and iLoc obtained low scores for availability and installation complexity, respectively.

Table 1. Final scores of competing artefacts

Competitor	*AC*	*AV*	*IC*	*UA*	*IIA*	*Final score*
n-Core	5,9611	9,8756	10	7.625	6.5	**7.14**
AIT	8,4540	1,3674	6,82	6,875	8,5	**5,90**
iLoc	7,8007	9,3922	0	5,875	4,5	**4,98**
OwlPS	1,3653	9,4337	8,4733	6,5	1	**4,85**
GEDES-UGR	1,8055	9,0193	0	6	10	**4,00**
SNTUmicro	0	0	10	4,375	3	**3,17**

AC: Accuracy
AV: Availability
IC: Installation Complexity
UA: User Acceptance
IIA: Integrability in AAL

5. Conclusions

The first EvAAL event involved the participation of a good number of teams, and provided much feedback to the organisers for subsequent events. We are now planning EvAAL 2012, which will open to new tracks (while keeping indoor localisation). In order to improve EvAAL we have prepared and distributed a call for ideas aimed at researchers, technicians, or even users. The purpose of the call for ideas is to collect suggestions for the improvement of the technical and organisational aspects of EvAAL, and to gather proposals for new topics. The call for ideas can be downloaded at the EvAAL website (http://evaal.aaloa.org). We conclude with a warm invite to everybody to help us make EvAAL a stable and widely recognised event for AAL.

For further reading about the organisational aspects of the first EvAAL event please read “EvAAL 1st Competition: Indoor Localization and Tracking for AAL” which is included in the current publication of the proceedings.

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TRACK F AT AAL FORUM 2010

TECHNOLOGY, PLATFORMS, STANDARDS, INTEROPERABILITY

Mohammad-Reza (Saied) Tazari[1]

Note

The Lecce Declaration presented earlier in these Proceedings has its roots in several community activities from the past. One of the initial related activities was the organisation of Track F of the AAL Forum 2010 in Odense, Denmark. Since by mistake no summary for Track F was included in the proceedings of the AAL Forum 2010, we asked one of the chairs to provide this summary for the proceedings this year in order to keep track of the valuable community work that has laid the cornerstone for further steps towards consensus building in technological matters.

Abstract

As a multidisciplinary technological approach, AAL involves (too) many different standards at diverse levels of hardware, software (architectures and interfaces), processes and services, data and content, etc. Considering that even simple sensors and actuators from a single domain are not interoperable by themselves, it should be obvious that complexity increases dramatically when several different domains, such as health, well-being, comfort, entertainment, safety and security, home automation, and energy efficiency, are considered in a combined way for creating AAL applications and services. Hence, the AAL Forum 2010 organised Track F on "Technology, Platforms, Standards, Interoperability" to investigate two closely-related questions: the role of standards and platforms in coping with the challenge of interoperability in AAL as well as the obstacles to their wider adoption by technology providers.

Since neither the creation of the AAL platforms nor the development of related standards is in the focus of the AAL Joint Programme per se, it was expected that this track would play a bridging role between AAL JP on the one side, and the more long-term industrial activities towards standards as well as the strategic research on AAL platforms in the context of the Framework Programmes of the European Commission on the other.

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Consequently, Track F was organised in four preparatory sessions for looking at the standardisation and platform scene and collecting views on obstacles and possible strategies for overcoming them. In a fifth session, this track finished its work by a panel discussion for summing up the collected information and making recommendations to the AAL community and its Joint Programme. The following is a summary of these five sessions.

Track Chairs: Saied Tazari (Fraunhofer IGD), Ad van Berlo (Smart Homes), Peter Wintlev-Jensen (European Commission)

Session F1: Technical standards for AAL: Achievements and obstacles

Session Chair: Michael Strübin, Continua Health Alliance

In the spirit of the main question in Track F, the presentations in this session (cf. Table 1) introduced different standardisation efforts related to AAL. They provided an overview of the specific fields of activity and the important achievements to date, while addressing any obstacles encountered impeding the wider adoption in RTD.

The presentations and discussions in this session showed that the number of standards relevant for the realisation of the different AAL use cases is indeed very high, many of them even competing with each other in the sense of dealing with the same (or very similar types of) problem. For this reason the strategy of the Continua Health Alliance, according to which no new standards are developed but appropriate ones selected and promoted, was estimated as a very suitable pragmatic approach.

Table 1: Overview of the presentations in Session F1

Title	Presenter	Summary / Conclusions
The AAL Standardisation Scene	Luca Odetti from FATRONIK-Tecnalia (Italy) representing the AALIANCE project (www.aaliance.eu)	AAL Standardisation aims at facilitating interoperable systems beyond individual special-purpose solutions and across several domains (not only health but also assistance, social integration, safety, etc.). In addition to connectivity / protocols, important standardisation areas are: self-organisation, standard messaging formats across all sub-domains, and semantic interoperability based on standard ontologies for understanding message content.

The Role of CEN TC251 / WGIV in Interoperability Standards for Health	Thomas Norgall from Fraunhofer AAL Alliance / Fraunhofer IIS (Germany) representing CEN TC251 / WGIV (www.cs.tut.fi/sgn/wgiv/)	The history of developments on interoperability of medical devices (functionality, settings, measured data and alert information, remote control, patient information, etc.) towards ISO/IEEE 11073 health standards.
Introduction to HL7: the Health Level Seven Standards for Healthcare	Robert A. Stegwee from Capgemini Healthcare (Netherlands) representing the HL7 International Council (www.hl7.org)	An overview of healthcare-related standards at level seven of the ISO/OSI reference model, hence enabling the sharing and re-use of healthcare information (e.g. clinical trials, research, administrative, financial, resource utilisation, public health, and supply chain) using messaging and clinical documents, and services and providing functional models to ensure interaction
Continua Health Alliance – The Next Generation of Personal Telehealth is Here	Rick Cnossen from Intel Corporation (USA) representing Continua Health Alliance (www.continuaalliance.org)	An introduction to the Continua Health Alliance emphasising its trade-off policy (e.g. simplicity ↔ complexity, international ↔ regional, expediency ↔ additional capability, interoperability ↔ flexibility, guidelines ↔ standards) and its work on an end-to-end architecture that helps choose certain industry standards with a focus on individuals.
Open Health Tools (OHT)	Stefan Ohlsson from IBM Nordic (Sweden) representing Open Health Tools (www.openhealthtools.org)	OHT is an open source community of healthcare providers, related standardisation bodies, and related vendors with the aim that users have increasingly better and affordable access to (and use of) comprehensive health information. OHT implements recognised industry standards and best practices as open software in order to facilitate their uptake, on the one hand, and provide feedback to SDOs, on the other hand.

From another perspective, the presentations in this session were classified according to the different dimensions of standardisation: CEN and HL7 define standards, Continua is about using them, OHT provides open implementations for them, and the Continua guidelines “constrain” them by defining styles for using them. The two last dimensions (open source implementation and constraining guidelines) can be seen as the right work to achieve the more pragmatic and widespread adoption of standards.

Finally, it is worth mentioning that despite the health-related focus of the presentations in this session – that helped to gain a process view on the different dimensions of standardisation – the recommendation by the AALIANCE project in the first presentation (not to leave the other AAL-related domains orphans) was acknowledged as very important (see Table 1).

Session F2: Major AAL platform projects: achievements and obstacles – part 1

Session F3: Major AAL platform projects: achievements and obstacles – part 2

Session Chair: Sergio Guillen, ITACA @ Universidad Politécnica de Valencia

As a matter of fact, standards concentrate on very specific problems so that no single standard can handle the whole interoperability issue in such highly distributed and heterogeneous environments as smart homes for providing ambient assistance. Consequently, additional means are needed that provide holistic support for the development of AAL applications. AAL platforms are supposed to take such a holistic approach. Hence the presentations in these two sessions (see Table 2) were dedicated to the major platform projects of the Framework Programmes of the European Commission in order to examine how the AAL Joint Programme can use and transfer experience from them. The presenters were requested to not only give an overview of the exploitable results from their projects but also discuss how the effective transfer of results could work, and which barriers the projects envisage in this transfer.

Table 2: Overview of the presentations in the Sessions F2 and F3

Title	Presenter	Summary / Conclusions
Benefits of platform-based approaches for AAL (an initial motivating presentation)	Reiner Wichert from Fraunhofer IGD (Germany) representing Fraunhofer AAL Alliance (aal.fraunhofer.de)	The lack of business models for AAL was traced back to the problem of interoperability, that causes vendors to provide only isolated packaged solutions for specific problems which in turn leads to higher costs for end users. Platforms usually map several "low-level" interoperability standards to a unifying high-level interoperability solution and hence reduce costs by facilitating resource sharing across several packaged solutions and by eliminating the need for separate maintenance contracts for each isolated package.

The HYDRA Project	Atta Badii from the University of Reading (UK) and Mario Hoffman from Fraunhofer SIT (Germany) representing the HYDRA project (www.hydramiddleware.eu)	HYDRA has created an open source middleware for intelligent networked embedded systems that enables secure semantic interoperability of heterogeneous embedded devices distributed in smart environments. The project also provides several tools that account for ease of use. It is being used in successor projects as the underlying platform. Hence, the strategy for promoting project results includes the open source approach, tooling, and enlarging the community through successor projects.
i2home	Jan Alexandersson from DFKI GmbH (Germany) representing the i2home project (www.i2home.org)	i2home realises a unified model (based on URC – the ISO/IEC 24752 standard called Universal Remote Console) for creating user interfaces for accessing distributed capabilities made available through a network, with a focus on home environments. The implemented middleware is being used in successor projects as the underlying platform. An international consortium of companies has been established (openURC) that commits to the promotion of the URC standard based on the i2home outcomes. One of the running action points in the successor projects is about tooling.
Netcarity – Ambient Technology to Support Older People at Home	Petr Křemen from the Czech Technical University in Prague representing the Netcarity project (www.netcarity.org)	Netcarity develops an end-to-end HW/SW infrastructure supporting the delivery of social, health, protection and entertainment services to homes of older people also involving service centres, family members, and acquaintances. An important feature of the solution is its support for privacy protection based on the P3P standard of W3C.
MPOWER – Challenges and Opportunities	Sten Hanke from the Austrian Institute of Technology (AIT) representing the MPOWER project (www.sintef.no/mpower)	MPOWER has created a middleware platform for the development of smart home systems by encapsulating services through SOA architecture, based on model-driven development and using standards such as ISO/IEEE 11073 and HL7, the SOA4HL7 methodology, the IBM SOA reference architecture, and the IBM software service UML profile. The

		project results have been made available as open source. A lightweight community building approach is being followed up through Sourceforge for further development, but the main exploitation strategy relates to acting as an input project for universAAL.
Major AAL Platform Projects – The OASIS case	Pilar Sala from ITACA-TSB (Spain) representing the OASIS project (www.oasis-project.eu)	OASIS aims at providing a Common Ontology Framework that makes it possible to define a Hyper-Ontology, which can be stored, accessed, and maintained within an Ontology Repository. Additionally, a Concept Anchoring and Alignment Tool is supposed to facilitate the integration of external Web services. The interoperability between services that use different ontologies is ensured by support for ontology mapping. OASIS has joined the community building efforts started by PERSONA and universAAL and is currently one of the eight projects supporting AALOA. It is also an official input project for universAAL.
PERSONA: AmI distributed platform for the delivery of AAL Services	Juan Pablo Lázaro Ramos from ITACA-TSB (Spain) representing the PERSONA project (www.aal-persona.org)	PERSONA treats an AAL Space as an open distributed self-organising system that evolves over time according to individual needs as they arise. Consequently, it abstracts an AAL Space as a dynamic ensemble of networked nodes and provides a distributed middleware solution for the discovery of such nodes and the exchange of messages between them, while hiding the distribution and heterogeneity. On top of this communication middleware, support is provided for context-awareness, service-based interoperability, adaptive user interaction, and integration of special-purpose devices. This whole framework has been made available under the Apache License 2.0. PERSONA was an initiator of AALOA and has provided its software for any further development. It is also an official input project for universAAL. Lack of development tools and the extreme

		openness of the platform (with its highly generalised approach that treats AAL Spaces as ecosystems of independently developed HW and SW components) were seen as possible barriers for the adoption of PERSONA software.

To summarise, different strategies are followed by the above projects for facilitating the usage of their respective platforms: providing the software as open source possibly with permissive licenses, broadening the developer base by reusing the platform in new projects with new consortia, providing development support especially via development tools, and ensuring maintenance and improvement by either continuing the work on them in new projects or by building communities that take over the further development. What seems to be an obstacle in the way of wider adoption is the lack of consensus building processes that help reduce the number of parallel solutions to just few basic ones, quite similar to the operating system market. Therefore, it was recommended that the AAL Joint Programme should encourage the usage of existing platforms in its Calls so that no money is spent on redoing things already done, on the one hand, and speeding up consensus building on this important groundwork, on the other hand.

Session F4 universAAL – Consolidation, Open Source, & Community Building

Session Chair: Reiner Wichert, Fraunhofer AAL Alliance c/o Fraunhofer IGD

As shown in the sessions F2 and F3, the production of software infrastructures supporting AAL has been the core topic of a number of EU projects. The legacy of these projects should not be allowed to die after the end of the projects; rather their further maturation should be promoted and supported. With the goal to achieve this, universAAL, an FP7 project started in February 2010, is applying different processes and tools: A consolidation process of existing architectural designs in order to converge to a common reference architecture; an open source reference implementation of a consolidated platform with permissive licenses (e.g. MIT and Apache License 2.0) based on such reference architecture and reusing existing software as much as possible; and a consensus building process to be carried forward by a large community composed of representatives of AAL stakeholders. In this session these tools and processes were briefly introduced.

Table 3: Overview of the presentations in Session F4

Title	Presenter	Summary / Conclusions
universAAL – UNIVERsal open platform and reference	Joe Gorman from SINTEF ICT (Norway) coordinator of the	An overview of the objectives, results and planned approach of the universAAL project was provided. universAAL is an EU-funded project which aims to

specification for AAL	universAAL project (www.universaal.org)	consolidate earlier research results in AAL, and to develop a standardised approach to developing AAL services. It started in February 2010 and will run for four years. The project will provide a reference architecture for AAL, and run-time support as well as support for developers. Adoption of these results as a standard approach is of crucial importance in the project, and to that end the project includes activities aimed at community building: to gather together people involved in this area, and make sure their needs and opinions are included in the platform being developed.
Consolidation: The technical challenge in universAAL	Saied Tazari from Fraunhofer IGD (Germany) responsible for the implementation of the universAAL platform	As probably the last AAL platform project with EU-IST funding, a major goal of universAAL is the provision of an open and scalable technological platform that facilitates the development and deployment of a broad range of AAL services. The main approach to achieve this is the consolidation of the state-of-the-art results from both existing standards and existing projects and initiatives and incorporating them into the design and implementation of the universAAL platform. In this talk, the applied consolidation methods in the different stages, such as use case and requirements specification, architectural design, and implementation, were reviewed. Furthermore, the achievements so far and further plans as well as the engineering challenges linked with the chosen approach of consolidation were reported. The main focus in the presentation of the achievements was on the first versions of a reference model for AAL and a component and a distribution view on the architecture of AAL Spaces.
AALOA – The AAL Open Association	Francesco Furfari from CNR-ISTI (Italy), the first signatory of the AALOA (www.aaloa.org)	Described the ongoing initiative of founding an AAL Open Association that is supported by an increasing number of European projects: BRAID, MonAmI, OASIS, OSAmI-Commons, PERSONA, SOPRANO, universAAL, and WASP. The

	manifesto (www.aaloa.org/manifesto)	mission of AALOA is to create a shared open framework for developers, technology and service providers, research institutions and end-user associations to discuss, design, develop, evaluate and standardise a common service platform in the field of Ambient Assisted Living. Rationale and purposes of the association were presented together with the roadmap for the next years.
EvAAL – Evaluating AAL Systems Through Competitive Benchmarking	Stefano Chessa from CNR-ISTI (Italy) representing the Steering Board of EvAAL (evaal.aaloa.org)	Evaluation of AAL systems is particularly challenging due to the complexity of such systems and to the variety of solutions adopted and services offered. This problem is clearly related to the evaluation of pervasive and ubiquitous systems that has been the focus of many researchers in recent years and that still awaits solutions. On the other hand, analysing and comparing AAL solutions is paramount for the assessment of the research results in this area. EvAAL (Evaluating AAL Systems Through Competitive Benchmarking) is a recently established international competition that aims to address this problem in order to let benchmarking and comparison methodologies of AAL systems emerge from the experience. This talk described the framework under which EvAAL operates and presented the EvAAL objectives, strategy and organisation.

Session F5 Concluding Discussions

Session Chairs: Joe Gorman (SINTEF ICT) and Ad van Berlo (Smart Homes)

The idea was to use this session to further discuss the issues addressed in the previous four sessions (the chairs of this session, as the moderators of the discussions, were responsible for gathering them) and debate to which extent the universAAL approach introduced in F4 could be promising for coping with the challenges addressed in F1 to F3; what advice can be given to universAAL on its way towards its goals; and which complementary arrangements could be added to the agenda of EU-IST Framework Programmes and the AAL Joint Programme.

For the sake of well-organised discussion and better time management a panel was organised, which was formed by:

- Niels Boye, AAL Joint Programme Central Management Unit
- Sergio Guillen, ITACA @ Universidad Politécnica de Valencia
- Gaby Lenhart, Senior Research Officer, ETSI
- Mário Romão, Continua Health Alliance c/o Intel Corporation
- Reiner Wichert, Fraunhofer AAL Alliance c/o Fraunhofer IGD
- Peter Wintlev-Jensen, Head of Sector, European Commission

The session chairs gathered 21 concrete questions from the F1 to F3 sessions. Due to time limitations, however, the panellists had to choose one specific question from the 21. In the following some recorded statements are summarised.

Mr. Boye analysed AAL in the health-related market and complained that currently AAL is often only being associated with very old people who suffer from certain diseases; but the truth is that the treatment of diseases is a specialised matter and the corresponding market is already filled with telemedicine solutions. The consequence is that only a small market niche remains (elderly in the initial phases of health-related problems) that is hard to penetrate due to low level of demand. Hence, the recommendation is that in health-related issues AAL should widen its scope to include aspects related to prevention and life style, on the one hand, and chronic disease management, on the other hand. In both cases, it is also possible to attract younger people and probably eliminate age-related boundaries for AAL.

Mr. Guillen questioned the supposed "vision", as if in the future people would go to the market to buy sensor nodes. Sensors only become meaningful in the context of a more comprehensive service that provides people with something of value concretely demanded. This is the other side of the coin compared with the idea of separating the applied usage of data from the device providing the data. It is true that if this separation takes place the same device can be used in the realisation of several different services, which has benefits for both the producer (more copies of the same product can be sold) and the consumer (resource sharing and hence cost reduction). However, end users might not be able to imagine the value of the device per se if it is not associated with an application. For this reason, service delivery packages must be built, in which devices are optional items and must only be bought if you have not previously acquired a similar device in the context of another service delivery package.

Ms. Lenhart took standardisation in energy efficiency as an example, and stated that even if such specific standardisation efforts might seem to proceed faster, they do not negatively affect the opportunities for AAL. AAL should make use of synergies. However, the reality is that currently the interoperability problems resist and working service packages still have to rely on proprietary solutions, even if individual parts might rely on certain standard protocols such as ZigBee or KNX. She also emphasised that in parallel to technical work on solving the problem of interoperability with the help of technical standards and platforms, special attention should be paid to user acceptance, since the average citizen might not be as excited about technology as presumed by the engineers.

Mr. Romão advocated the policy of the Continua Health alliance in creating guidelines supported by a large number of companies with regard to the promotion of certain standards for two reasons: firstly, there are a lot of competing standards and it might be difficult to pick the “right” one; secondly, many of the standards are just too diverse and flexible. Guidelines do not replace standards, they narrow down and define working sets that have been tested in plug fests. Another point that should be highlighted is that Continua started from very specific needs, very specific use cases. A use case is as simple as a blood pressure gauge sending data out to somewhere else. He suggested that universAAL should also follow this successful strategy by working on the basis of simple use cases. Similarly, universAAL should involve as much of the industry as possible, especially the big players, just like Continua did, in order to speed up the process of reaching the critical mass. Last but not least, universAAL should try to find the right balance between prescription, on the one hand, and flexibility, on the other hand, both in the specification of the reference architecture and in the realisation of the platform in order to allow for creativity, innovation and competition.

Mr. Wichert stressed that although a platform approach helps reduce costs, e.g. by facilitating resource sharing for different applications, it is not enough for market penetration. We also need to distribute the costs over time. People, irrespective of age, do spend money for safety, comfort, fun, and luxury; if AAL platforms are flexible enough and support the evolve-ability of AAL systems, each individual could start with investments in his/her own AAL system at a young age according to his/her own needs, preferences, and financial power. Energy efficiency is one of the domains with connections to AAL and it is possible to wow people with it regardless of age. It is simply “cool” for younger people to live in a smart home, and hence they will also spend money for it. Here, the construction industry is starting to make all building installations controllable through programming interfaces. Open platforms can help speed up this process; if they solve the interoperability problem at a semantic level and support evolve-ability then the costs can be distributed over time and application. Other financing mechanisms can then facilitate this process, e.g. conditional reduction of insurance fee and taxes. Sometimes, like in the case of energy efficiency, over time you might even save more money than you invest. So my motto is (1) certain platform approaches and based on that (2) breaking out of the restrictions, such as age and health.

Mr. Wintlev also talked much about the importance of platform approaches for AAL. In the case of energy efficiency, for example, politicians will provide many incentives for saving energy which is also an opportunity for the platform approach because we are not going to have 20 different platforms with which people cannot cope due to their complexity and / or cost. Besides, a lot of the needed functionality is actually very similar, even when not the same. Incidentally, starting with energy efficiency applications for younger ages in smart homes is one of the most likely scenarios for deploying AAL platforms. Another important argument in favour of platform approaches is user interaction. Sometimes it is difficult enough to even use the interface of one device or service. With the increase in the bunching of functionality available in networked environments, it will become crucial to provide consistent interfaces with support for hiding complexity. Adding functionality to smart homes should have some analogy to receiving yet another channel on your TV (the interface of the TV remains the same no matter how many new channels you receive). Once you have the basic cost and you have a consistent user interface that the user is able to use then it should be fairly easy to add more and more features to such a system.

In addition to UI, important challenges for AAL platforms include reliability, privacy protection, evolve-ability and adaptability. AAL technologies will really impact on people's lives. The very frail people addressed by AAL have multiple needs that are changing very quickly; consequently it must be possible to change the functionalities quickly in an easy way. In the CIP programme of the European Commission (ec.europa.eu/cip/) for example, one of the assumptions is that roughly 80% of the requirements will be the same all over Europe, but you need to be able to adapt or localise the remaining 20% to the given organisational and cultural context. Regarding reliability, if you want to put a person with hard conditions at home rather than in an intense care unit and nevertheless expect that the doctor takes the liability if something happens to that person, then you must at least guarantee that the system will not fail. On the other hand, it is inevitable that home care involves new actors that share information about the assisted person. Depending on the societal culture, people might react differently to this fact; that is the level of sensibility with regard to privacy protection might differ significantly. Also for solving ethical issues the system should have the flexibility to adapt.

Concerning open source, Mr. Wintlev ranked it as a kind of intermediate step to get to a platform, because a single company will hardly be able to develop an AAL platform in midterm. Through an open source approach, in the first instance the knowledge will be captured, which is very important for the EC because it is no longer acceptable to fund projects that spend in the region of 60–70% of the project's resources just to get to a common level in order to be able to start with project-specific add-ons. This is a repeating pattern; every project does exactly the same things, even the same mistakes. Therefore capturing the knowledge is very important, the same as with Linux: you do not develop an operating system every time you want to use a computer, and the operating system captures the good knowledge and the experience so that you can concentrate on your specific solutions.

Finally, the participants agreed that at the very least a summary of these discussions be published on the AALOA Web site.

‘Active Ageing: Innovations, Market, and EU Initiatives’ was the theme of the third AAL Forum in the beautiful Baroque city of Lecce. The Forum 2011 invited us to discover the significant progresses made by the AAL JP projects and to think and contribute in shaping the future of ICT based supporting solutions for the senior population.

The Lecce Forum was co-organized by the AAL Joint Programme (AAL JP); a funding and support programme for innovative European research and development, with the aim of enhancing the quality of life of older people by ICT and strengthening the industrial base in Europe.

In addition, the Forum was organized by the Italian Ministry of Education University and Research (MIUR), the Puglia Region, the Institute for Microelectronics and Microsystem of the Italian National Research Council (CNR-IMM), the Province of Lecce, the Municipality of Lecce, the Italian Association Ambient Assisted Living (AitAAL), and Roma Multiservizi.

ISBN 978-90-819709-0-7

Smart Homes